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LAB W S HODGKISS ET AL. JAN 88 MPL-TM-399

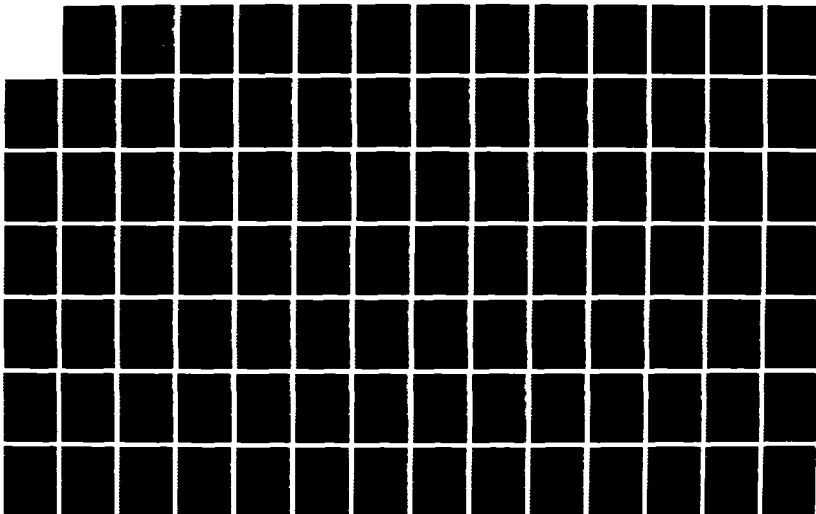
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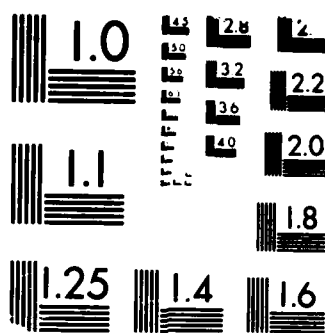
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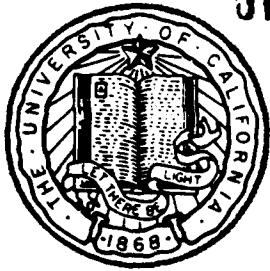
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MICROCOPY RESOLUTION TEST CHART  
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# MARINE PHYSICAL LABORATORY

SCRIPPS INSTITUTION OF OCEANOGRAPHY

San Diego, California 92152

AD-A193 586

## VERTICAL SIGNAL ARRIVAL STRUCTURE

W. S. Hodgkiss and F. H. Fisher



MPL-TECHNICAL MEMORANDUM 399

MPL-U-2/88

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## REPORT DOCUMENTATION PAGE

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| <p>As a natural part of our MPL vertical array ambient noise experiments, one or several index frequencies often are transmitted from the support tug which has towed FLIP out to station. Contained in this technical report are the complete signal analysis results for the NORDA VEKA 48-element vertical array Tape #85010. The tape was recorded at 32°N, 124°W (approximately 350 nmi due west of San Diego) on 18 October 1985 beginning at 20:05 PDT. At that time, the wind speed was 6 kts. Also contained in this report are the complete signal analysis results for the MPL 27-element vertical array Tape #86247. The tape was recorded at 32°N, 136°W (approximately 1000 nmi due west of San Diego) on 9 May 1986 beginning at 13:38 PDT. At that time, the wind speed was 17 kts.</p> |       |                                             |                                                                                                |                                                                                           |
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## Vertical Signal Arrival Structure

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### Abstract

As a natural part of our MPL vertical array ambient noise experiments, one or several index frequencies often are transmitted from the support tug which has towed FLIP out to station. Contained in this technical report are the complete signal analysis results for the NORDA VEKA 48-element vertical array Tape #85010. The tape was recorded at 32° N, 124° W (approximately 350 nmi due west of San Diego) on 18 October 1985 beginning at 20:05 PDT. At that time, the wind speed was 6 kts. Also contained in this report are the complete signal analysis results for the MPL 27-element vertical array Tape #86247. The tape was recorded at 32° N, 136° W (approximately 1000 nmi due west of San Diego) on 9 May 1986 beginning at 13:38 PDT. At that time, the wind speed was 17 kts.

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## I. Introduction

In a pair of experiments in 1985 and 1986, measurements were made of the ambient noise field between 25 and 300 Hz with vertical arrays at 32° N (124° W, 136° W, and 150° W). The analysis of the data from these experiments is documented in MPL-TM-387 (W.S. Hodgkiss and F.H. Fisher, "Vertical Directionality of Ambient Noise at 32° N as a Function of Longitude"). As a natural part of our MPL vertical array ambient noise experiments, one or several index frequencies often are transmitted from the support ship which has towed FLIP out to station.

Contained in this technical report are the complete signal analysis results for the NORDA VEKA 48-element vertical array Tape #85010. The tape was recorded at 32° N, 124° W (approximately 350 nmi due west of San Diego) on 18 October 1985 beginning at 20:05 PDT. At that time, the wind speed was 6 kts. Also contained in this report are the complete signal analysis results for the MPL 27-element vertical array Tape #86247. The tape was recorded at 32° N, 136° W (approximately 1000 nmi due west of San Diego) on 9 May 1986 beginning at 13:38 PDT. At that time, the wind speed was 17 kts.

## II. Experiment Description and Data Analysis

The data were obtained with two uniformly spaced arrays suspended in the vertical from FLIP and centered on the sound axis ( $z = 750$  m) - the 48 element NORDA VEKA array cut for 309 Hz ( $d = 2.4$  m) and the 27 element MPL digital array cut for 217 Hz ( $d = 3.46$  m). FLIP was in a tight, three-point moor at  $32^{\circ}\text{N}$ ,  $124^{\circ}\text{W}$  for the October 1985 data taken with the NORDA VEKA array and drifting slowly at  $32^{\circ}$   $136^{\circ}\text{W}$  for the May 1986 data taken with the MPL digital array. The figures at the end of this section show the array deployment scenario, the locations of the FLIP stations, and a sound velocity profile from October 1985 along with low-angle rays traced from a 750 m depth out to 700 km in range.

The NORDA VEKA array data discussed here were taken on 18 October 1985 starting at 20:05 PDT (Tape #85010, position  $32^{\circ}$   $124^{\circ}\text{W}$ , wind speed 6 kts). Twenty-one data segments each of length 72 s were analyzed (25.2 min total). With a sampling rate  $f_s = 907.8$  Hz, each segment consisted of 65536 samples/channel.

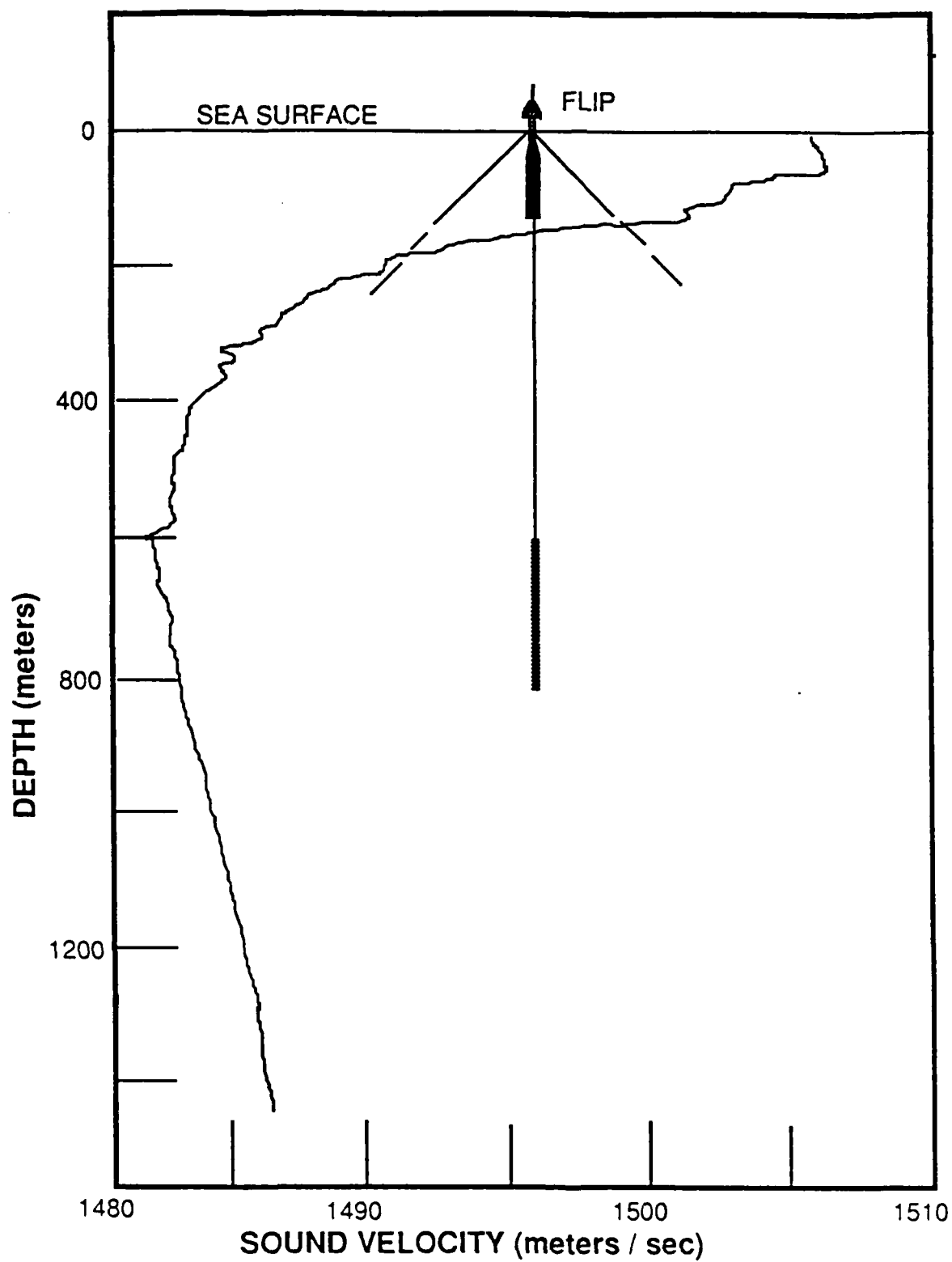
The figures in Section IVA display the power spectra of Channels #1, 16, 32, and 48 from the first segment of the NORDA VEKA array data (Channel #1 corresponds to the hydrophone at the top of the array). They were derived from the incoherent addition of 15, 50% overlapped, 8192-point FFT's (111 mHz bin width). A Kaiser-Bessel window ( $\alpha = 2.5$ ) weighted the data prior to each FFT. For this value of  $\alpha$ , the highest sidelobe level is -57 dB. The values reported in these figures are properly calibrated (dB re  $1 \mu\text{Pa}/\sqrt{\text{Hz}}$ ). The 90% confidence interval for these results is  $+2.0/-1.6$  dB. The very prominent line at slightly less than 250 Hz was an index frequency projected from the support ship as part of the experiment. The line at 174 Hz was generated on board FLIP.

The MPL digital array data discussed here were taken on 9 May 1986 starting at 13:38 PDT (Tape #86247, position  $32^{\circ}$   $136^{\circ}\text{W}$ , wind speed 17 kts). Twenty data segments each of length 55.7 s were analyzed (18.6 min total). With a sampling rate of  $f_s = 1176$  Hz, each segment consisted of 65536 samples/channel.

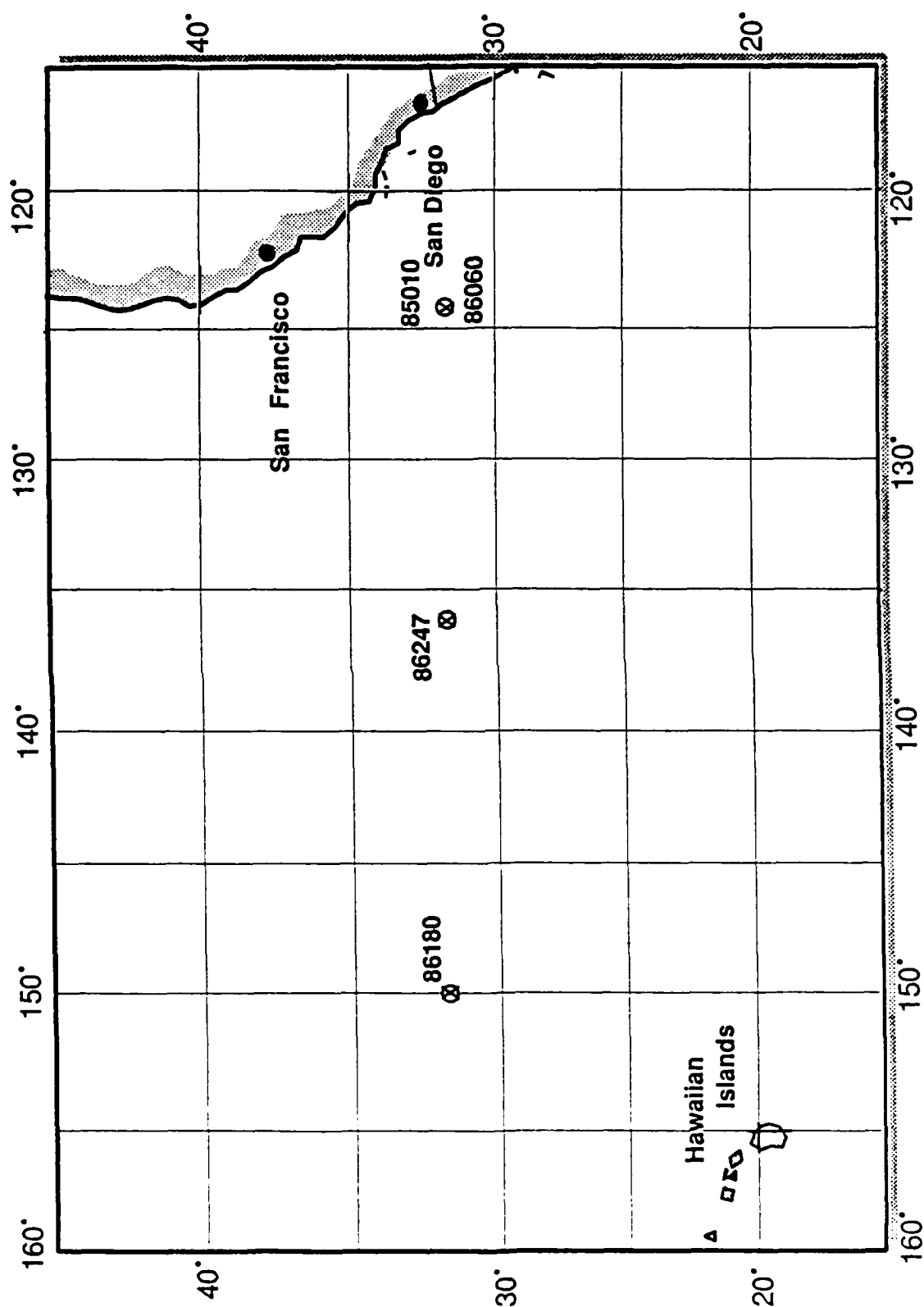
The figures in Section VA display the power spectra of Channels #1, 10, 20, and 27 from the first segment of the MPL digital array data (Channel #1 corresponds to the hydrophone at the top of the

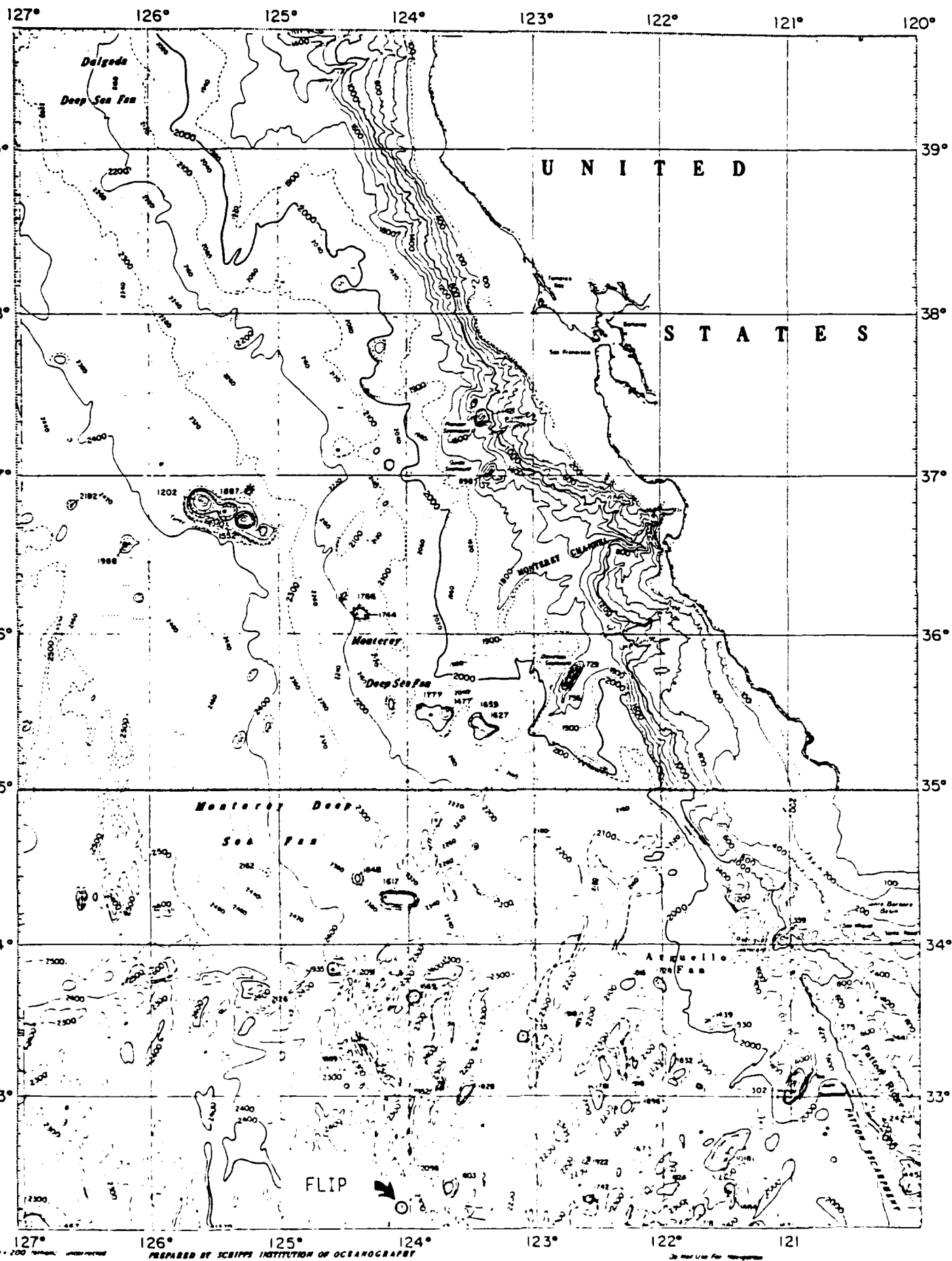
array). They were derived from the incoherent addition of 15, 50% overlapped, 8192-point FFT's (144 mHz bin width). A Kaiser-Bessel window ( $\alpha = 2.5$ ) weighted the data prior to each FFT. The values reported in these figures are properly calibrated (dB re 1  $\mu\text{Pa}/\sqrt{\text{Hz}}$ ). The 90% confidence interval for these results is +2.0/-1.6 dB. The very prominent line at slightly less than 250 Hz was an index frequency projected from the support ship as part of the experiment.

The results discussed in the next section were produced with a FFT beamformer. The along-channel FFT's were 50% overlapped and 8192-points in length. A Kaiser-Bessel window ( $\alpha = 2.5$ ) weighted the data prior to each FFT. The cross-channel FFT's were 512-points in length where the (complex) data first was windowed with a 48-point (NORDA VEKA array data) or a 27-point (MPL digital array data) Kaiser-Bessel window ( $\alpha = 1.5$ ) and then zero-padded out to the FFT length. For this value of  $\alpha$ , the first sidelobe is -35 dB. The figures in Sections IVB and VB display the beam patterns of both arrays at 250 Hz.

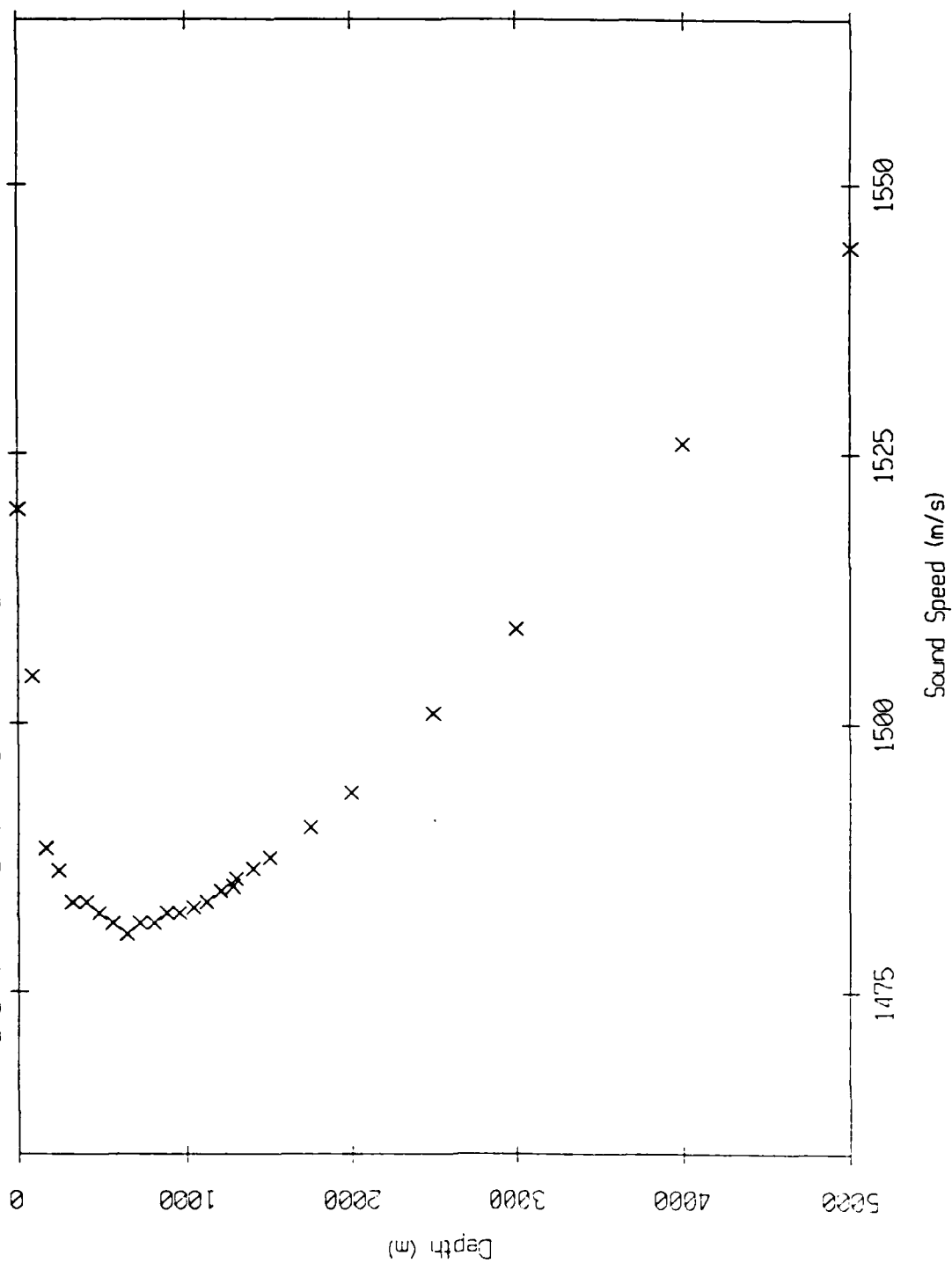


# *Hawaii to California*

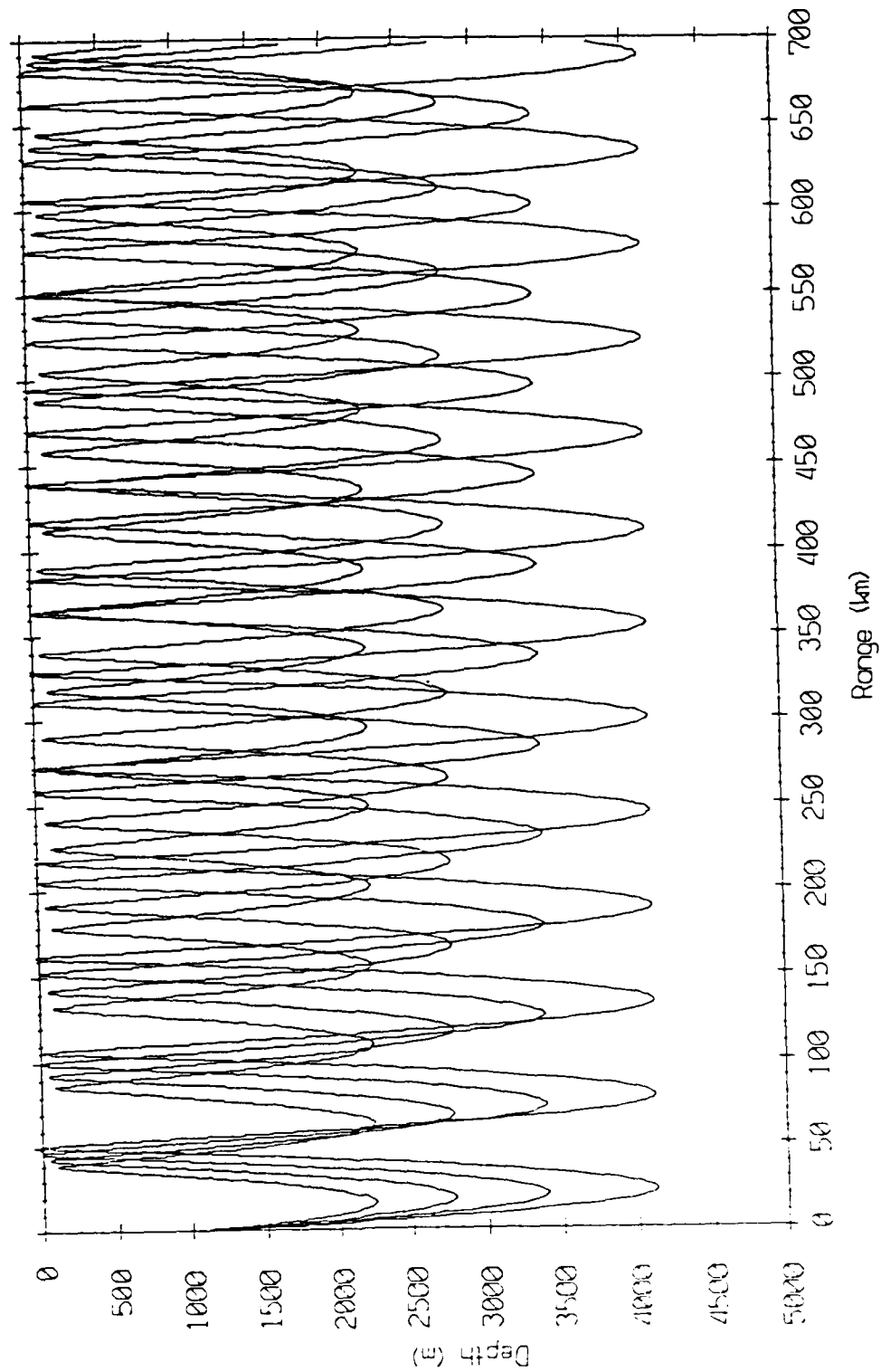




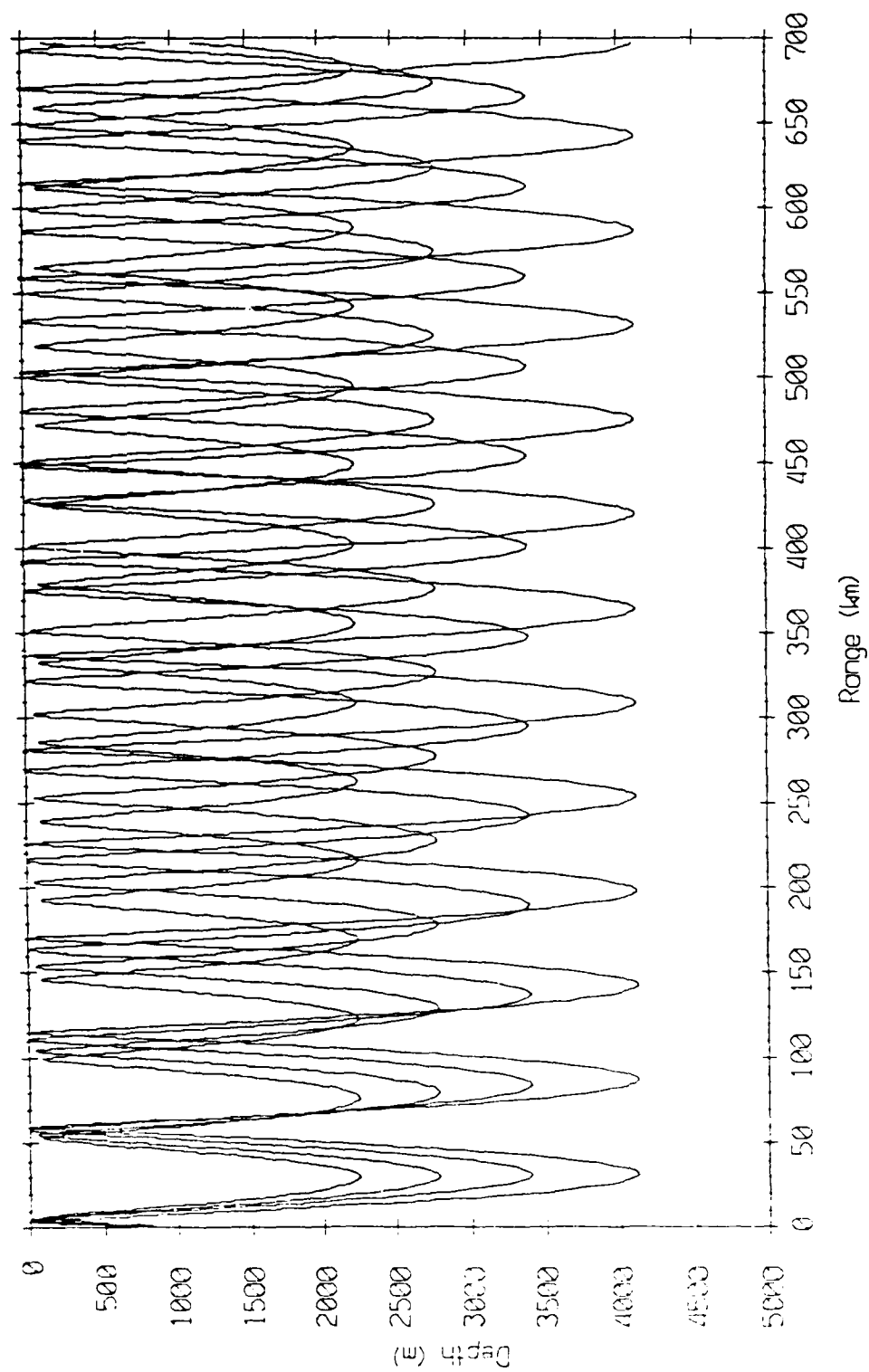
# CONTRACK VIII - 1985



CONTRACT VIII - 1985  
(8, 10, 12, and 14 deg)



# CONTRACT VIII - 1985 (-8, -10, -12, and -14 deg)



### III. Vertical Signal Arrival Structure and Vertical Directionality of Ambient Noise

Here, a brief guide will be provided to the array response results. They report the time-evolving character of both the vertical signal arrival structure and the vertical directionality of ambient noise. Positive angles refer to downward looking beams. The plots have been calibrated to report power spectral density per Hz per degree of vertical angle (dB re 1  $\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). Discussion related to the characteristic pedestal shape of the ambient noise vertical directionality and how it is influenced by local wind speed is contained in MPL-TM-387.

Tape #85010 (Section IV) is from the NORDA VEKA array at 124° W. The plots represent a (time) FFT bin width of 111 mHz. At the time the data was recorded, the support ship (MAJESTIC SEAHORSE) was located at 35° 33'N 124° 54'W (~200 nmi from FLIP) with a course of 348° T and speed of 6.1 kts. Three index frequencies at different levels were transmitted by an HX-90 sound source at a depth of ~91 m: (1) 245 Hz (135 dB// $\mu\text{Pa}$ ), (2) 250 Hz (174 dB// $\mu\text{Pa}$ ), and (3) 255 Hz (154 dB// $\mu\text{Pa}$ ). For each source frequency, four FFT bins were beamformed - the two bins closest to the Doppler shifted source frequency and two noise bins located 5 bins below and 5 bins above the two signal bins.

Tape #86247 (Section V) is from the MPL digital array at 136° W. The plots represent a (time) FFT bin width of 144 mHz. At the time the data was recorded, the location of the support ship (USNS NARRAGANSETT) was unknown but believed to be ~25-30 nmi from FLIP. One index frequency at 250 Hz and level 174 dB// $\mu\text{Pa}$  was transmitted by an HX-90 sound source at a depth of ~147 m. Five FFT bins were beamformed - the three bins centered on the source frequency and two noise bins located 5 bins below and 5 bins above the two outer signal bins.

Sections IVC and VC (Array Response: Waterfall, KB Window) provide waterfall plots of the time-evolving vertical directionality of ambient noise and vertical signal arrival structure for successive segments (65536 points) across the entire data tape (dB// $\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). A Kaiser-Bessel window ( $\alpha = 1.5$ ) was used to amplitude shade the array elements.

Sections IVD and VD (Array Response: Waterfall, Rect Window) provide waterfall plots of the time-evolving vertical directionality of ambient noise and vertical signal arrival structure for successive

segments (65536 points) across the entire data tape ( $\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). A rectangular window was used to amplitude shade the array elements.

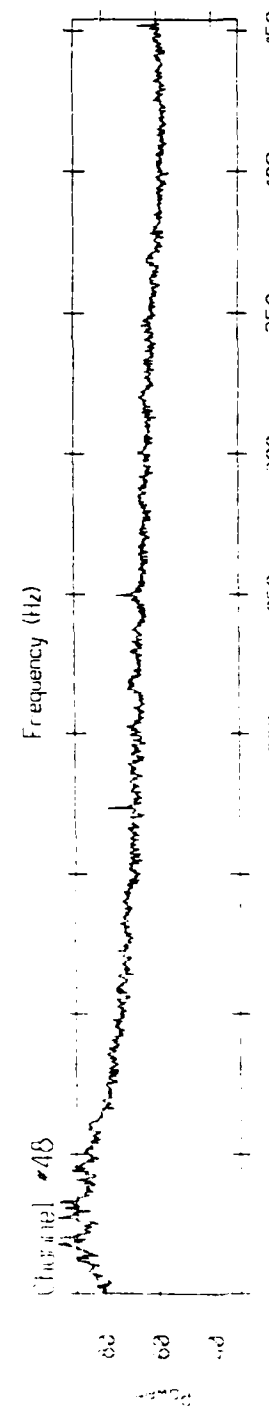
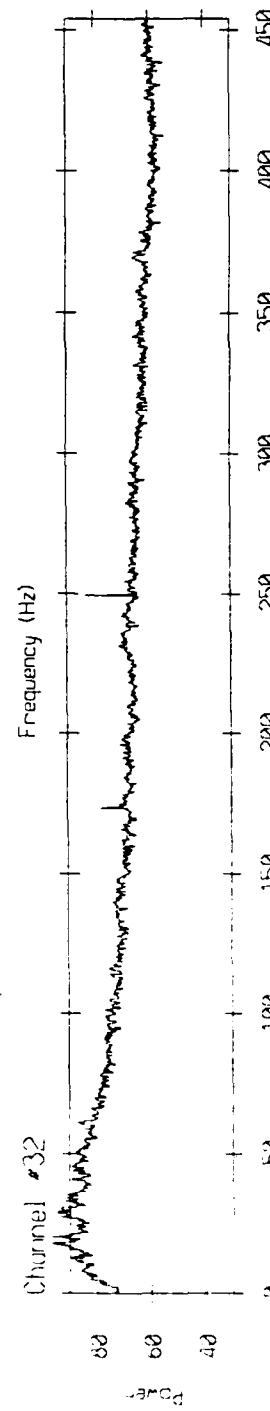
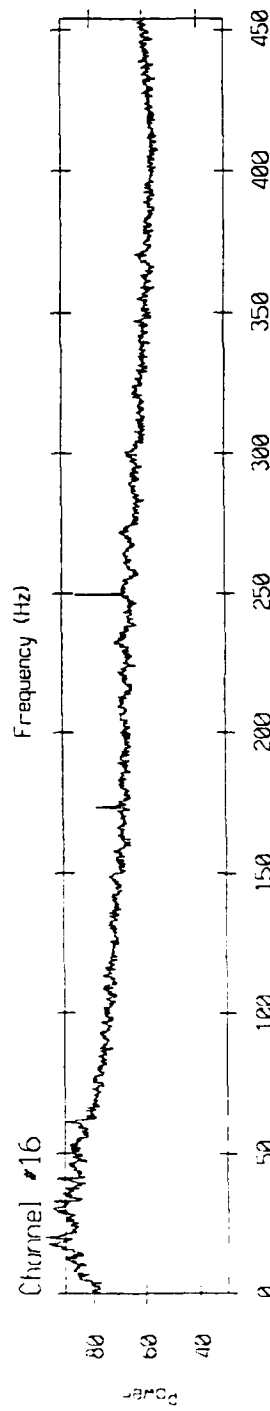
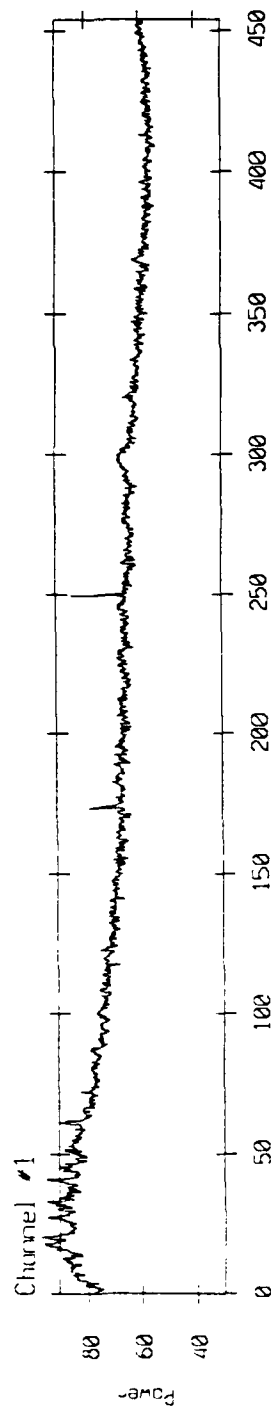
Sections IVE and VE (Array Response: Panels, KB Window) provide multi-panel plots of the time-evolving vertical directionality of ambient noise and vertical signal arrival structure for successive segments (65536 points) across the entire data tape ( $\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). A Kaiser-Bessel window ( $\alpha = 1.5$ ) was used to amplitude shade the array elements.

Sections IVF and VF (Array Response: Panels, Rect Window) provide multi-panel plots of the time-evolving vertical directionality of ambient noise and vertical signal arrival structure for successive segments (65536 points) across the entire data tape ( $\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$ ). A rectangular window was used to amplitude shade the array elements.

IV. Tape #85010.

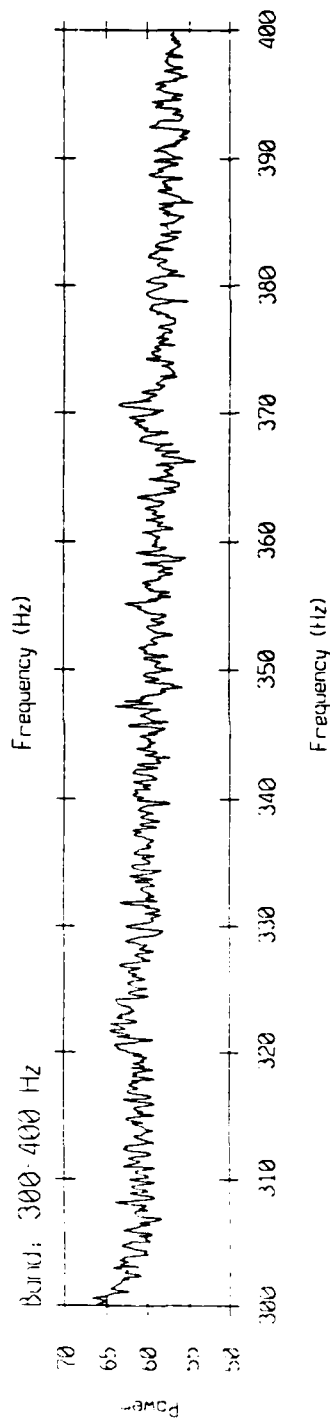
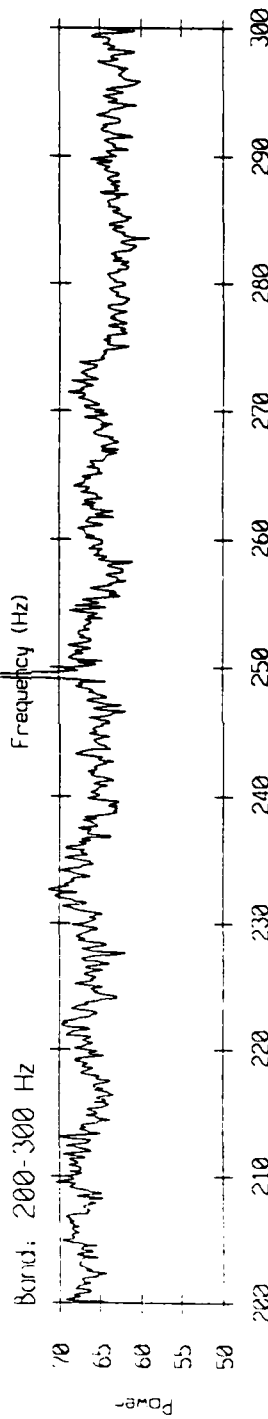
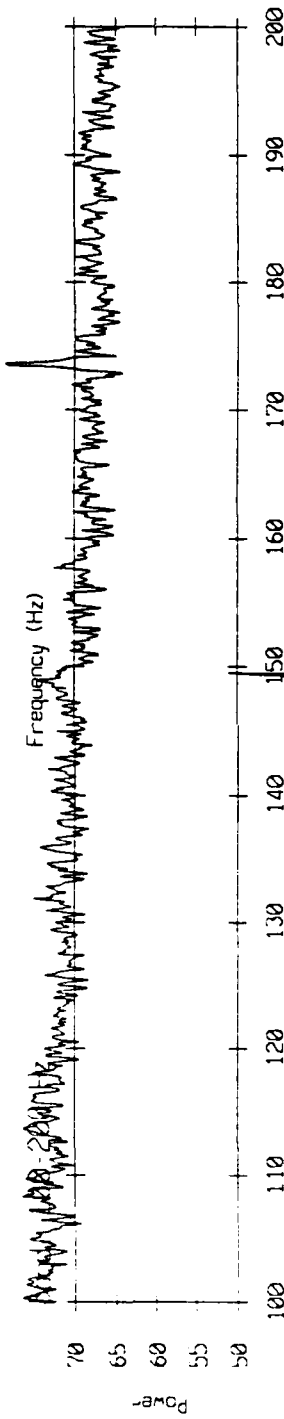
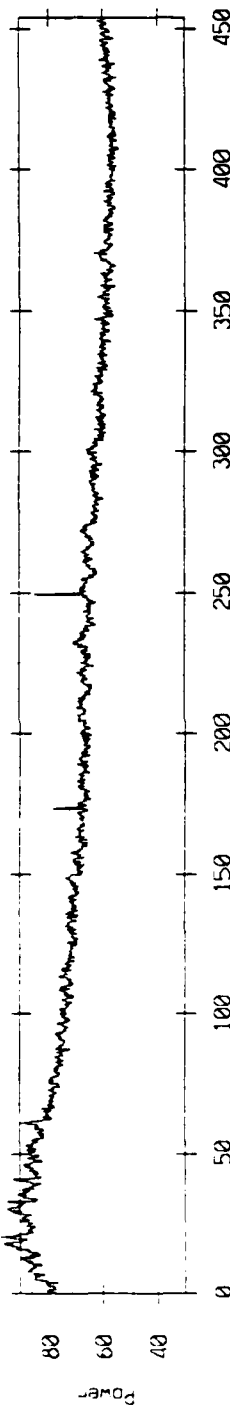
A. Power Spectra.

Power Spectrum - 85010.1



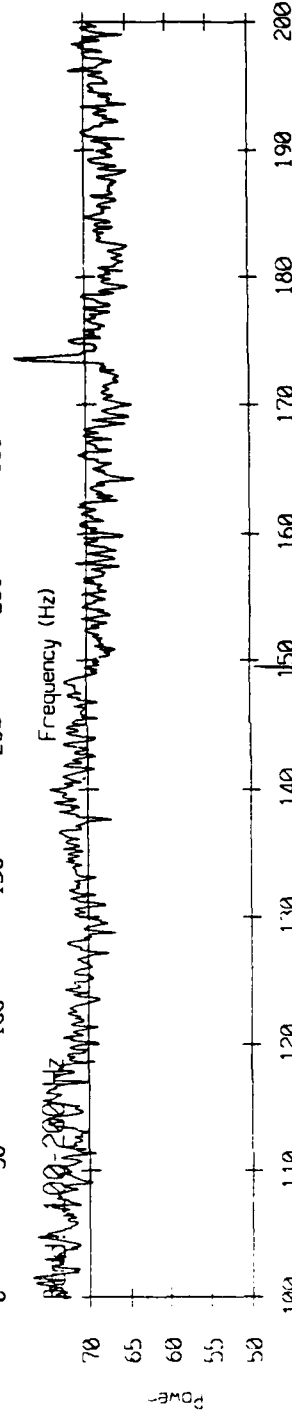
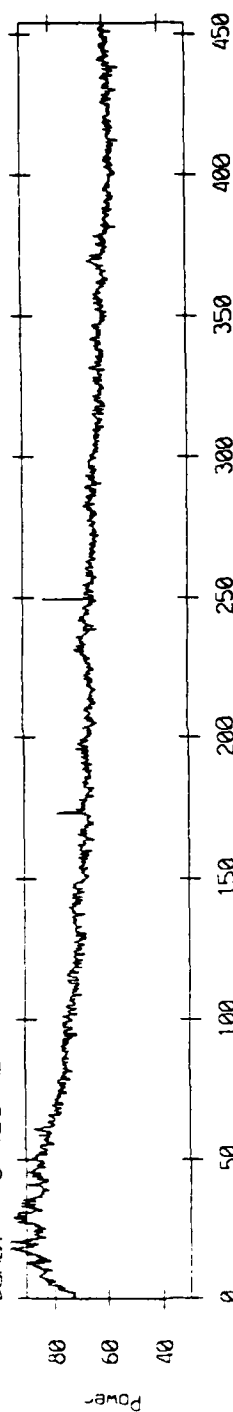
Power Spectrum - 85010.1 Channel #16

Band: 0-450 Hz

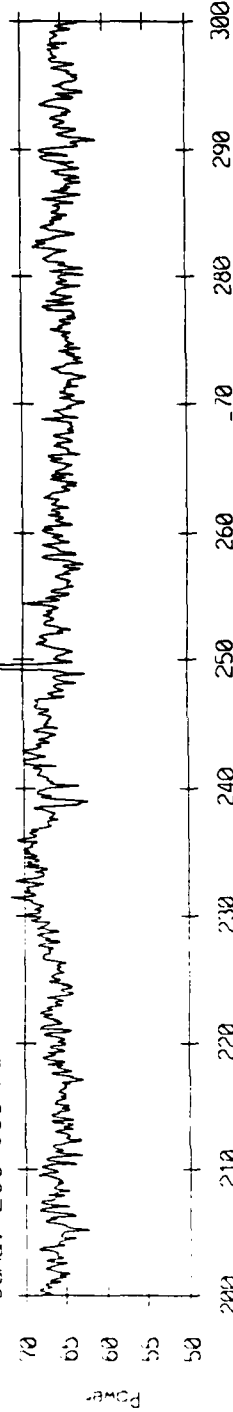


Power Spectrum - 85010.1 Channel #32

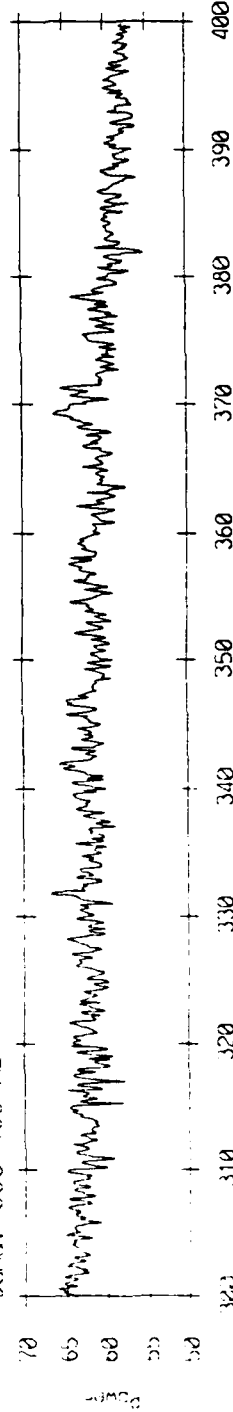
Band: 0-450 Hz



Band: 200-300 Hz

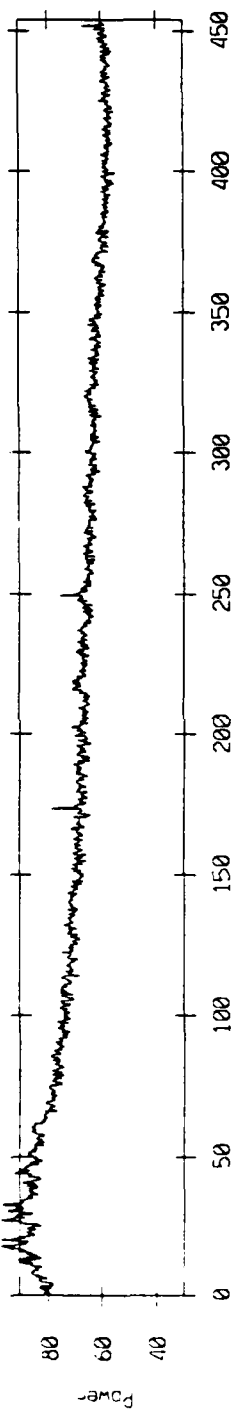


Band: 300-400 Hz

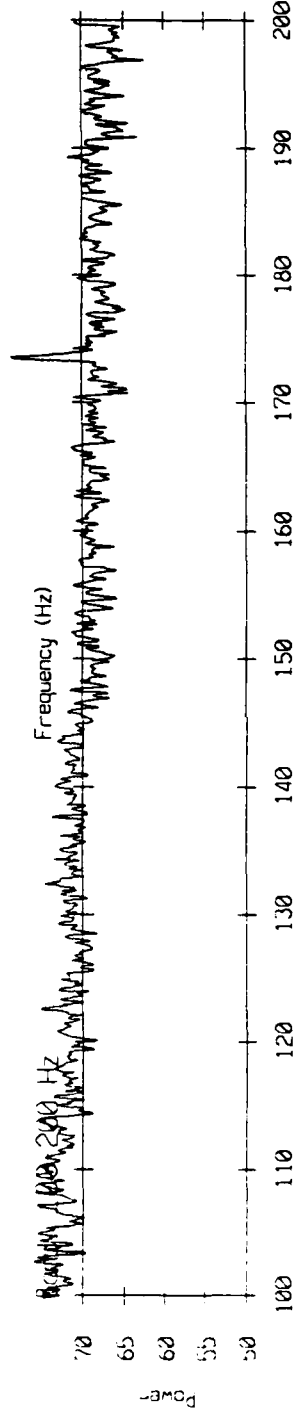


Power Spectrum - 85010.1 Channel #48

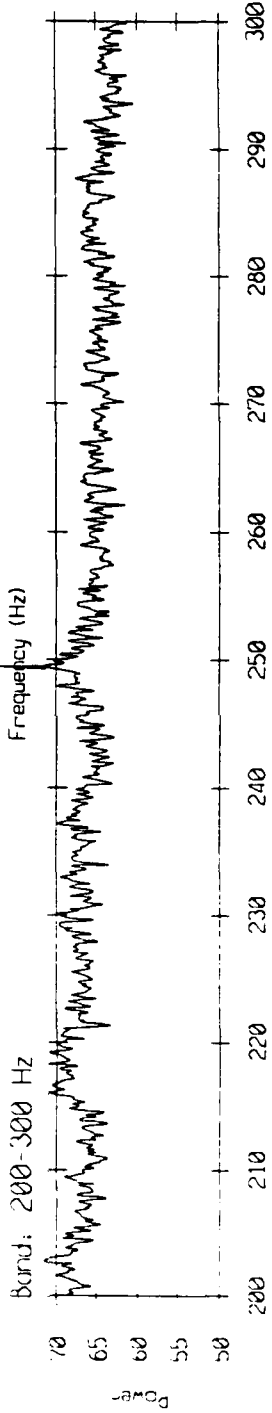
Band: 0-450 Hz



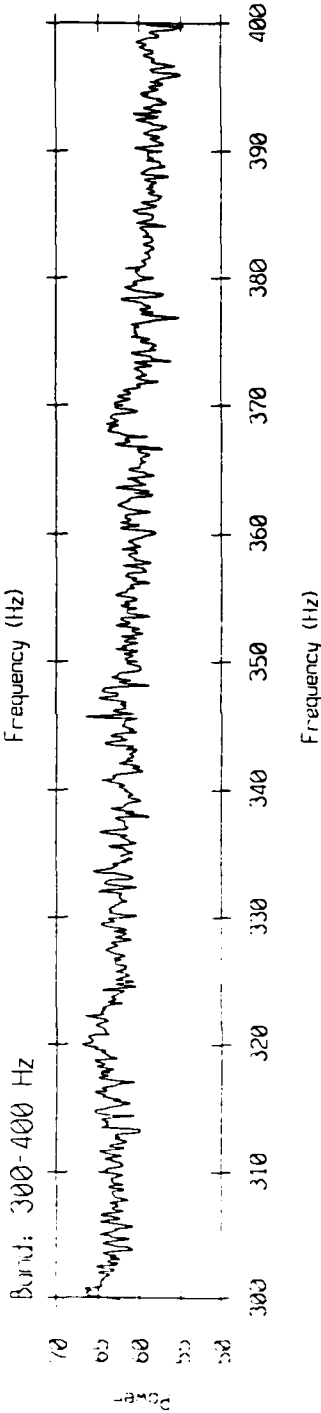
Band: 200-290 Hz



Band: 200-300 Hz



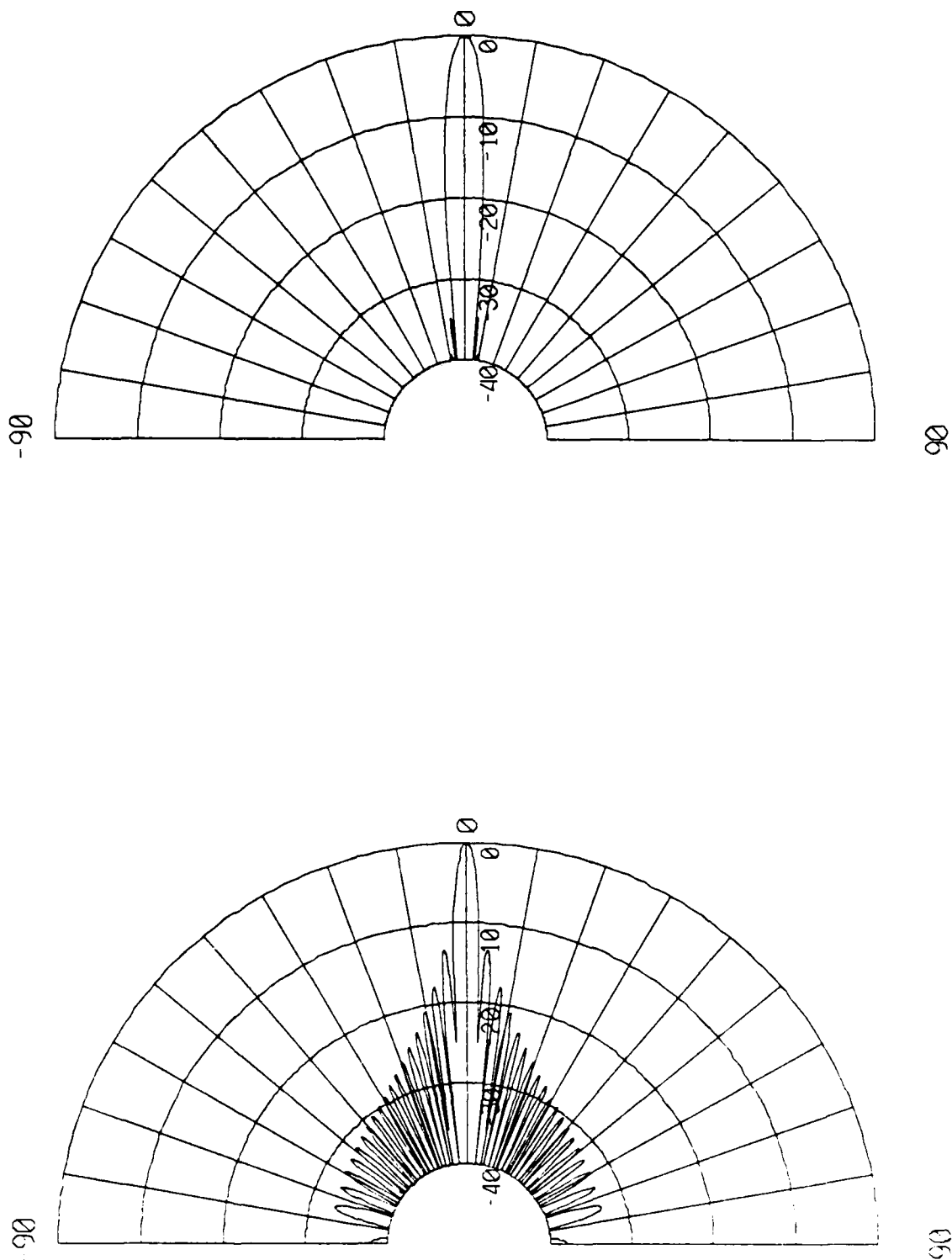
Band: 300-400 Hz



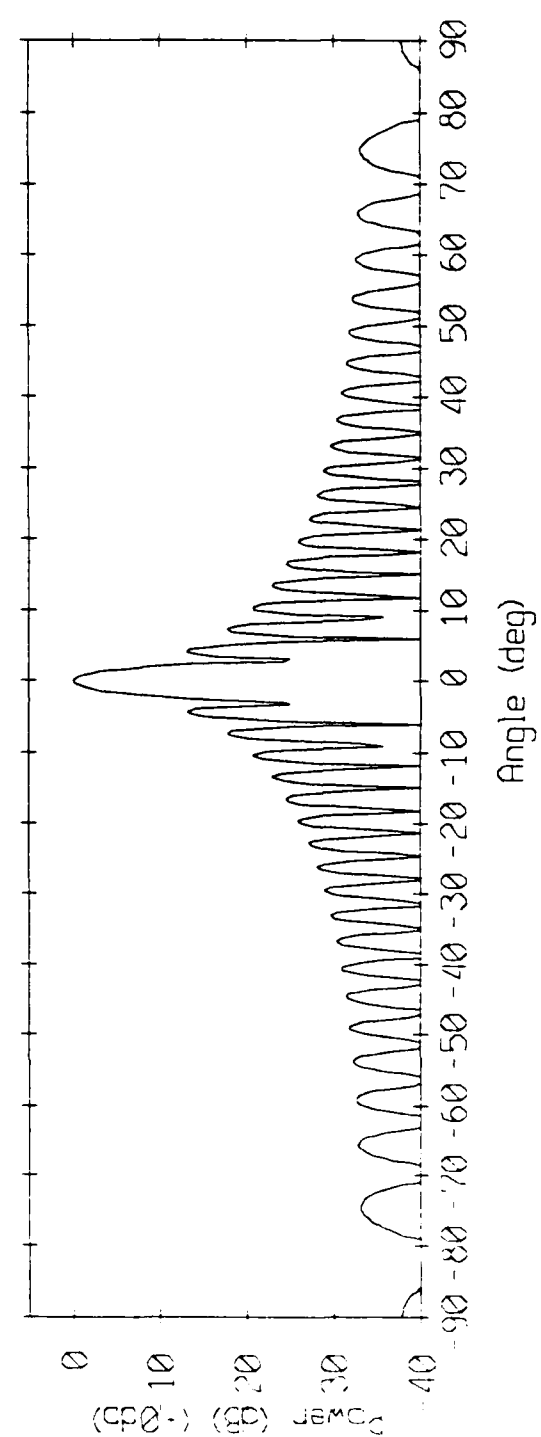
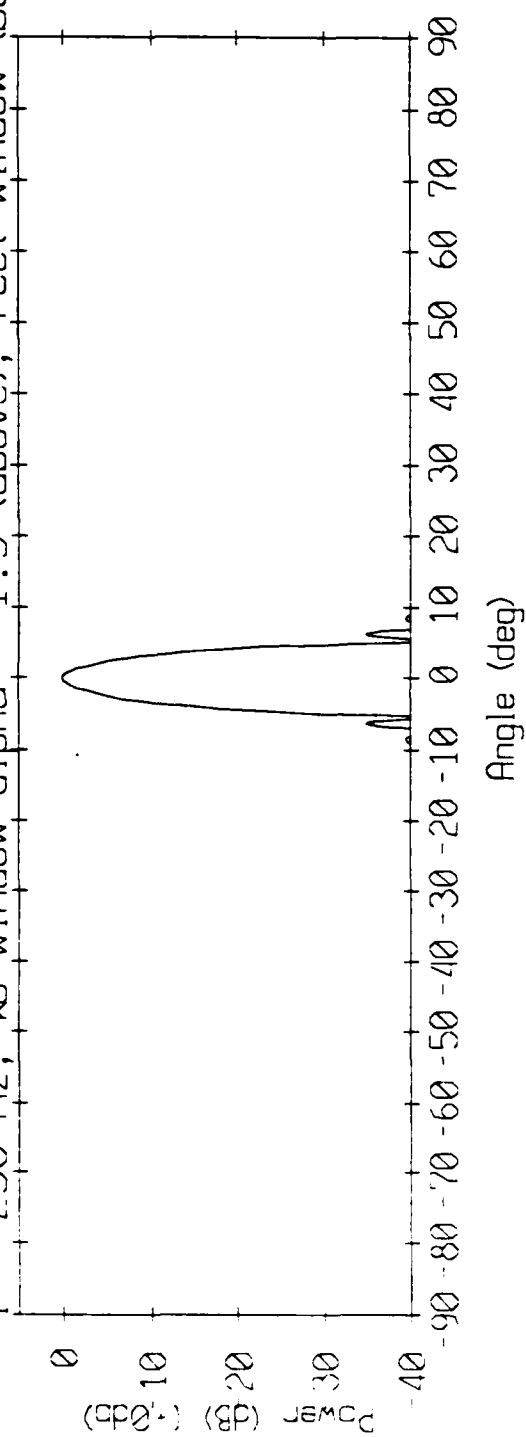
IV. Tape #85010.

B. Beam Patterns (250 Hz).

VEKN Array Beam Pattern:  
 $f = 250$ , rect window (left), KB window ( $\alpha_{pho} = 1.5$ ) (right)



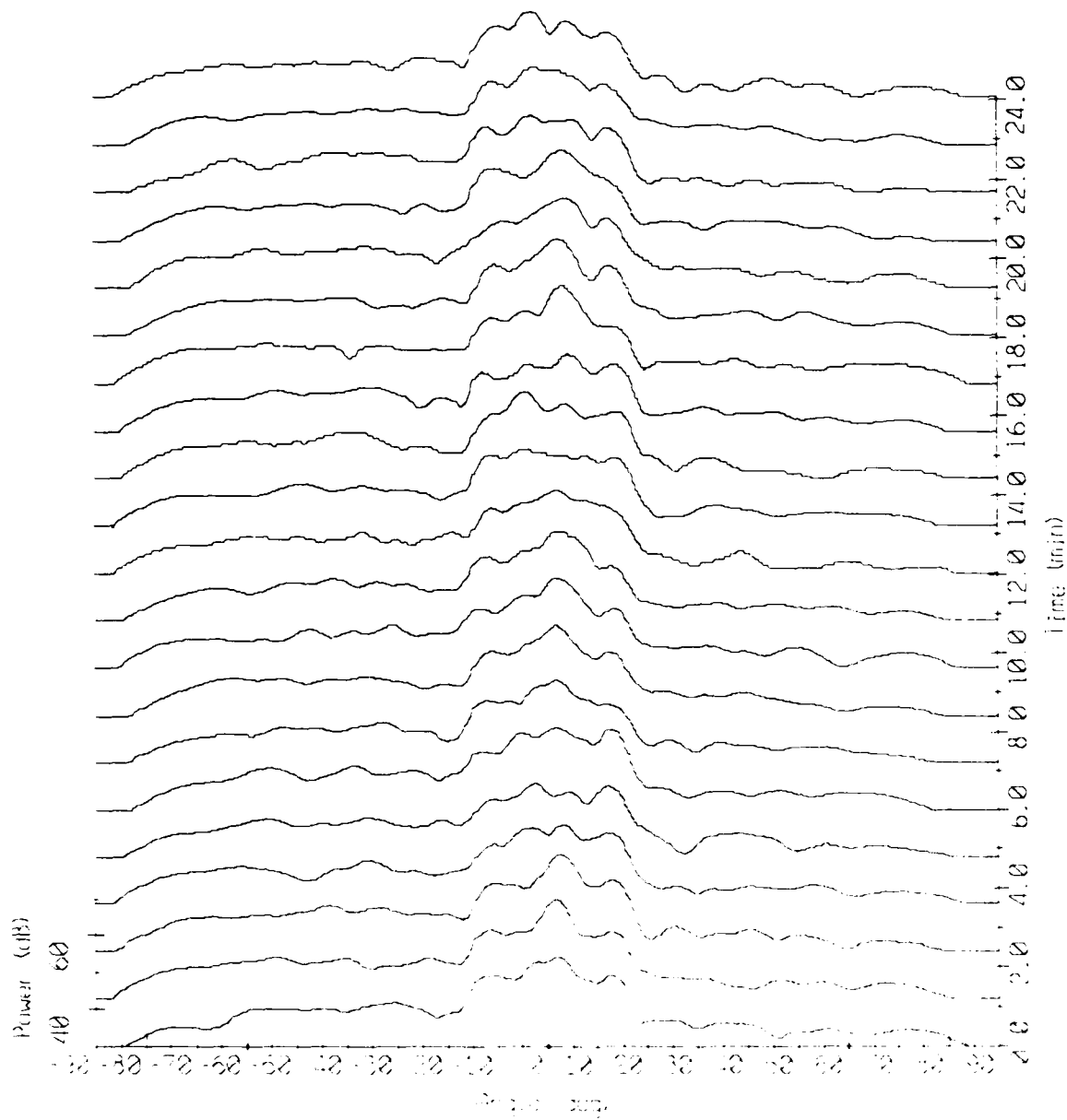
VEKA Array Beam Pattern  
 $f = 250$  Hz, kb window  $\alpha = 1.5$  (above), rect window (below)



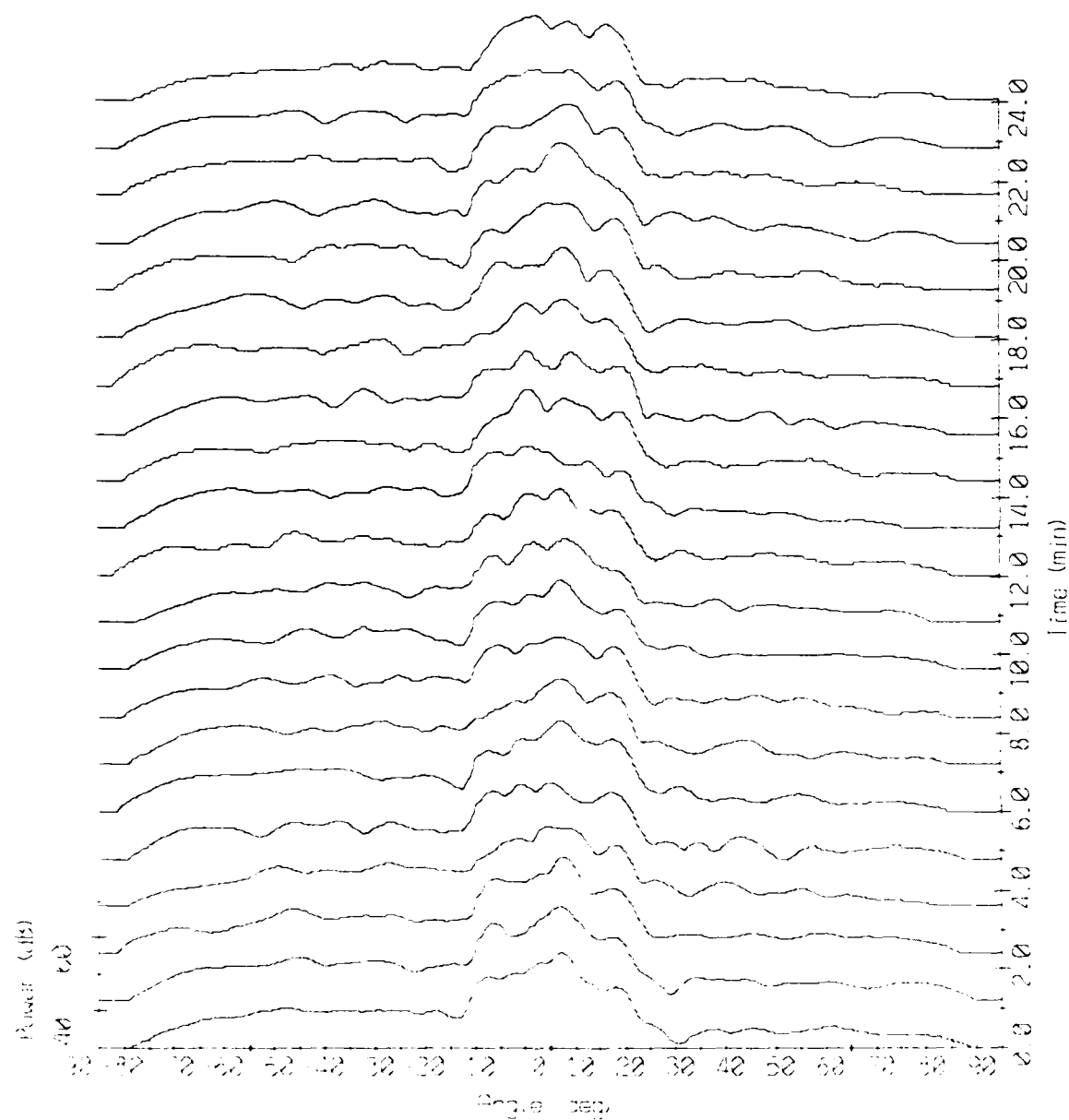
IV. Tape #85010.

C. Array Response: Waterfall, KB Window.

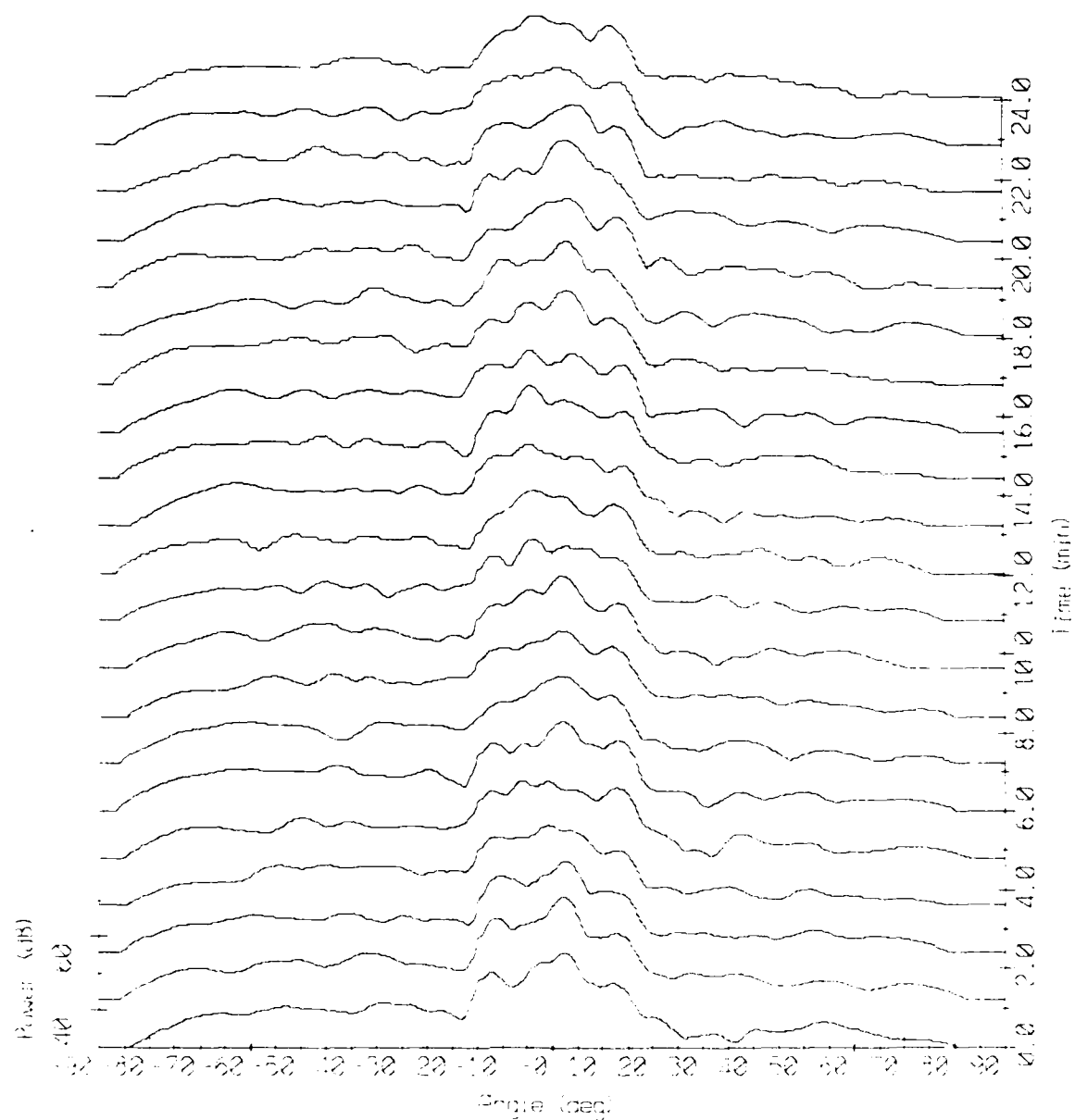
Array Response - 85010 Bin #6298  
 $f = 243.90$  Hz, KB window (alpha = 1.5)



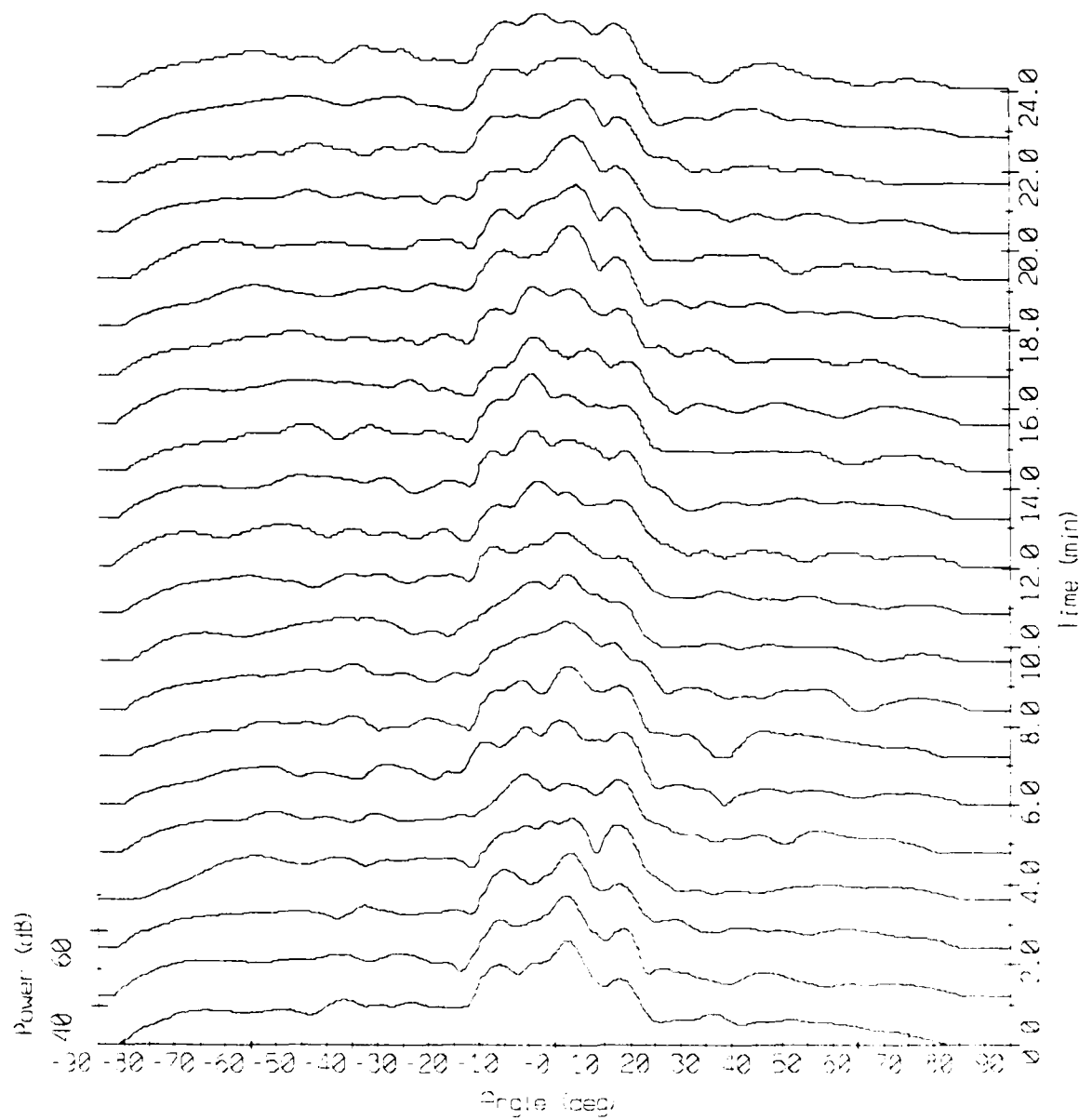
Array Response - 85010 Bin #6303  
 $f = 244.45$  Hz, KB window (alpha = 1.5)



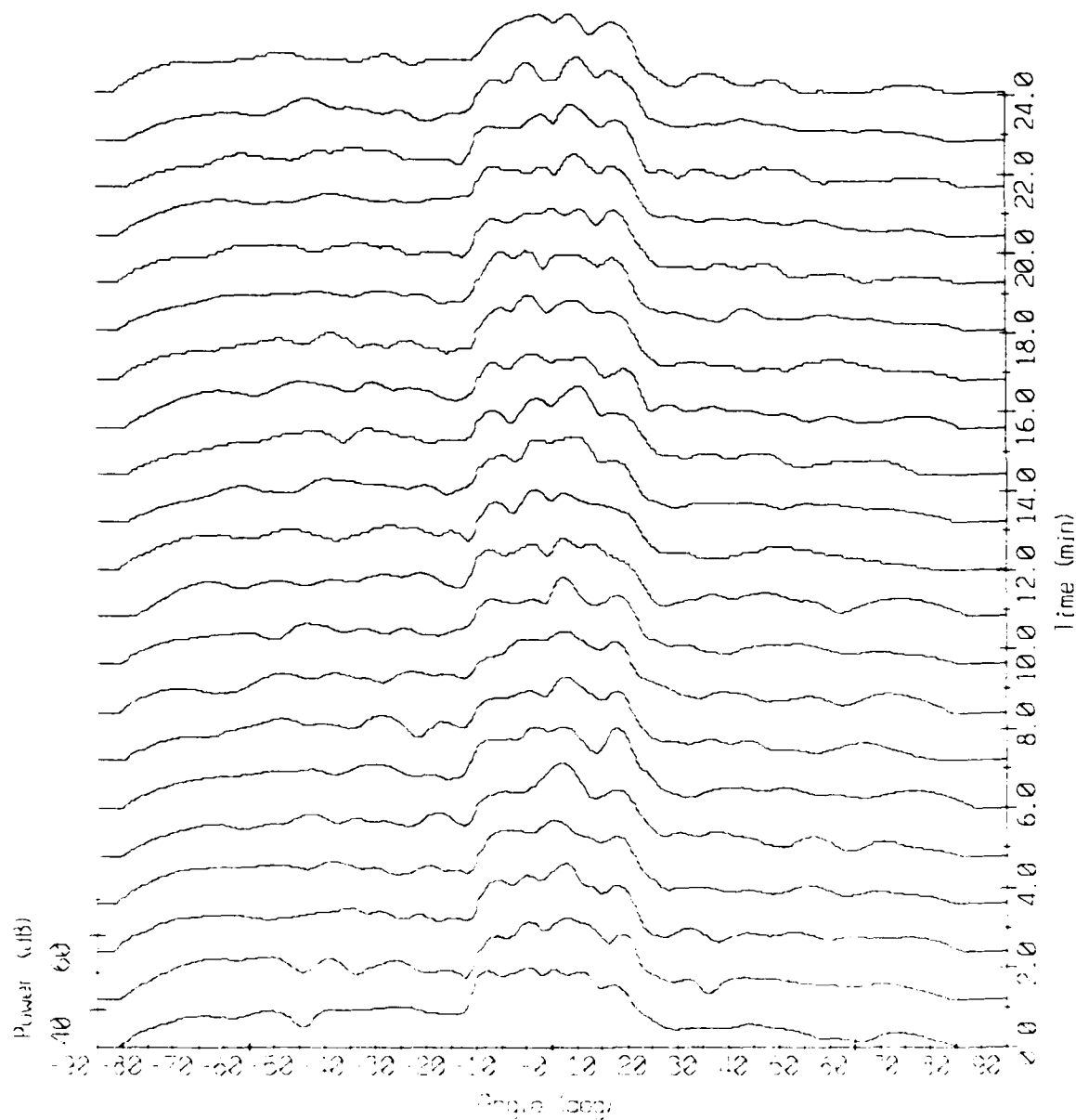
Array Response - 85010 Bin #6304  
 $f = 244.45$  Hz, KB window ( $\alpha = 1.5$ )



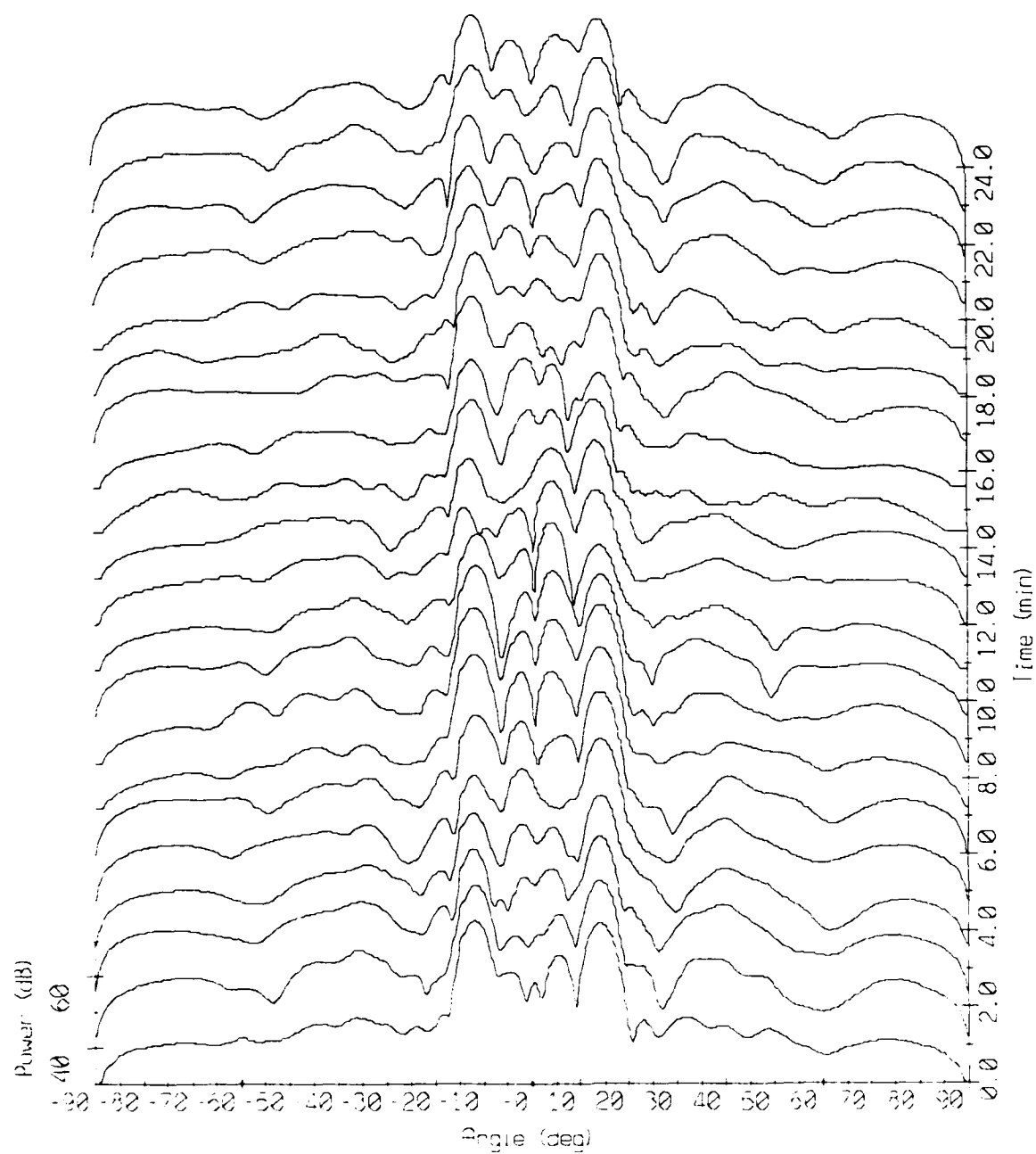
Array Response - 85010 Bin #6309  
 $f = 245.12$  Hz, KB window ( $\alpha = 1.5$ )



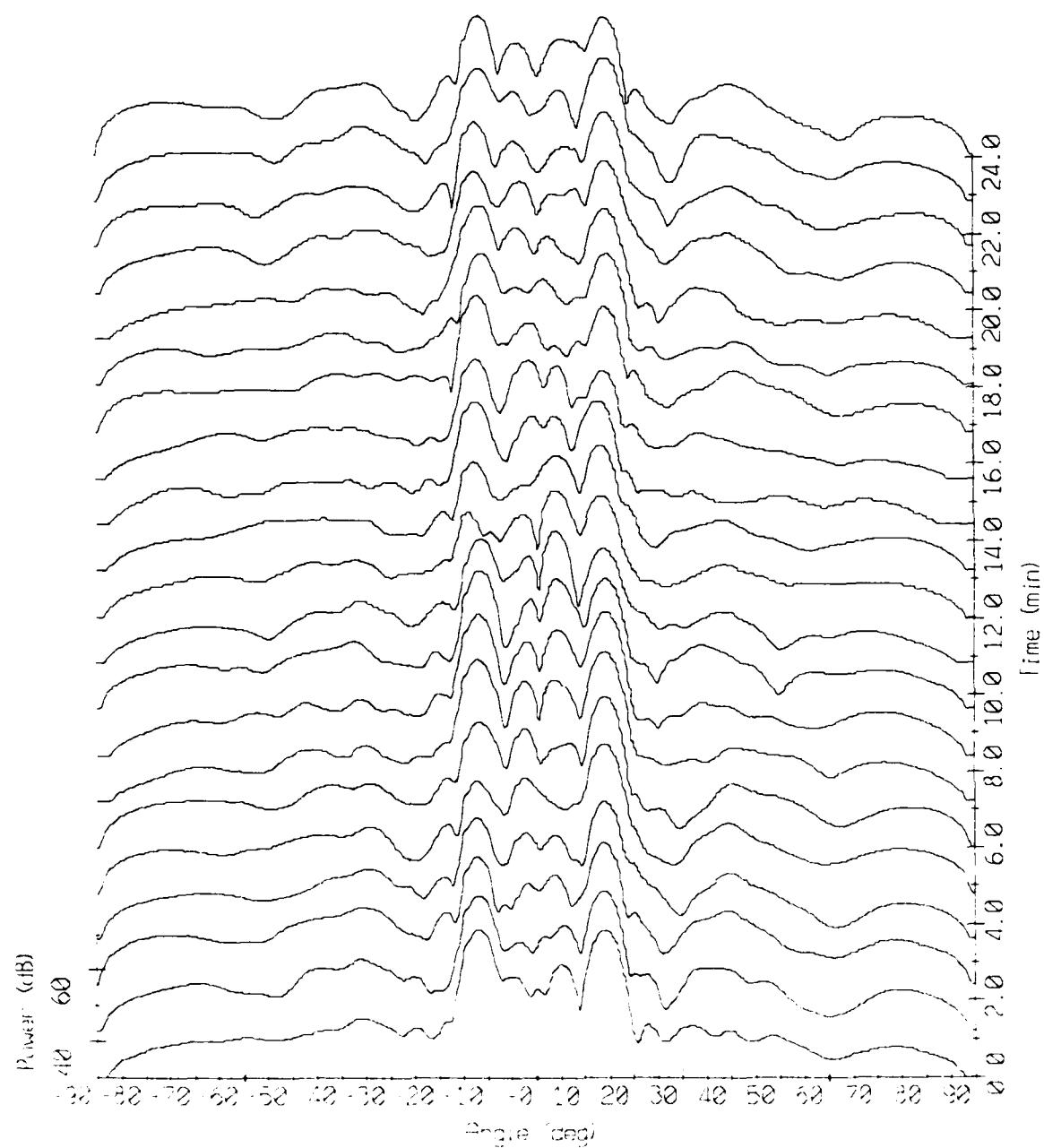
Array Response - 85010 Bin #6343  
 $f = 248.88$  Hz, KB window ( $\alpha = 1.5$ )



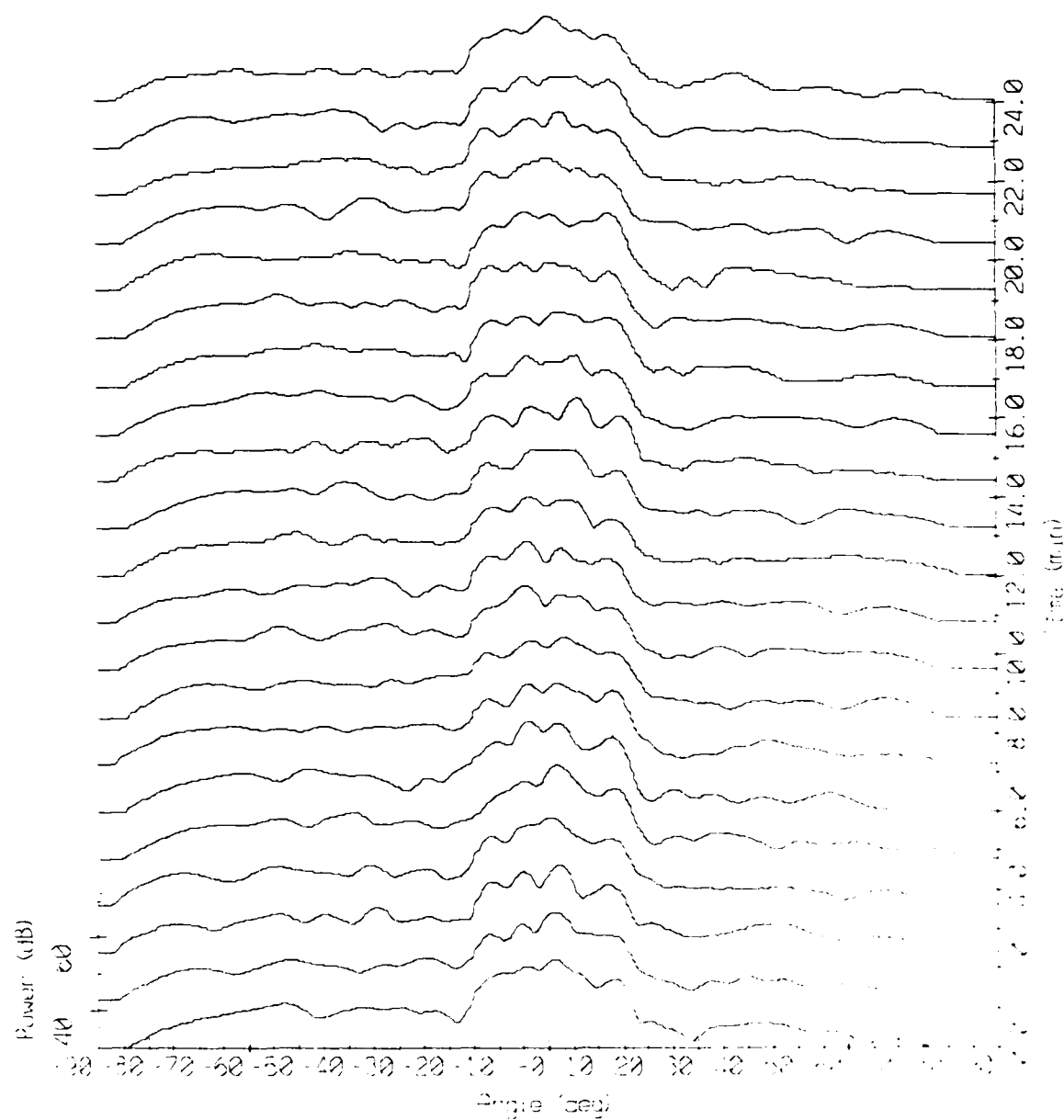
Array Response - 85010 Bin #6348  
 $f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



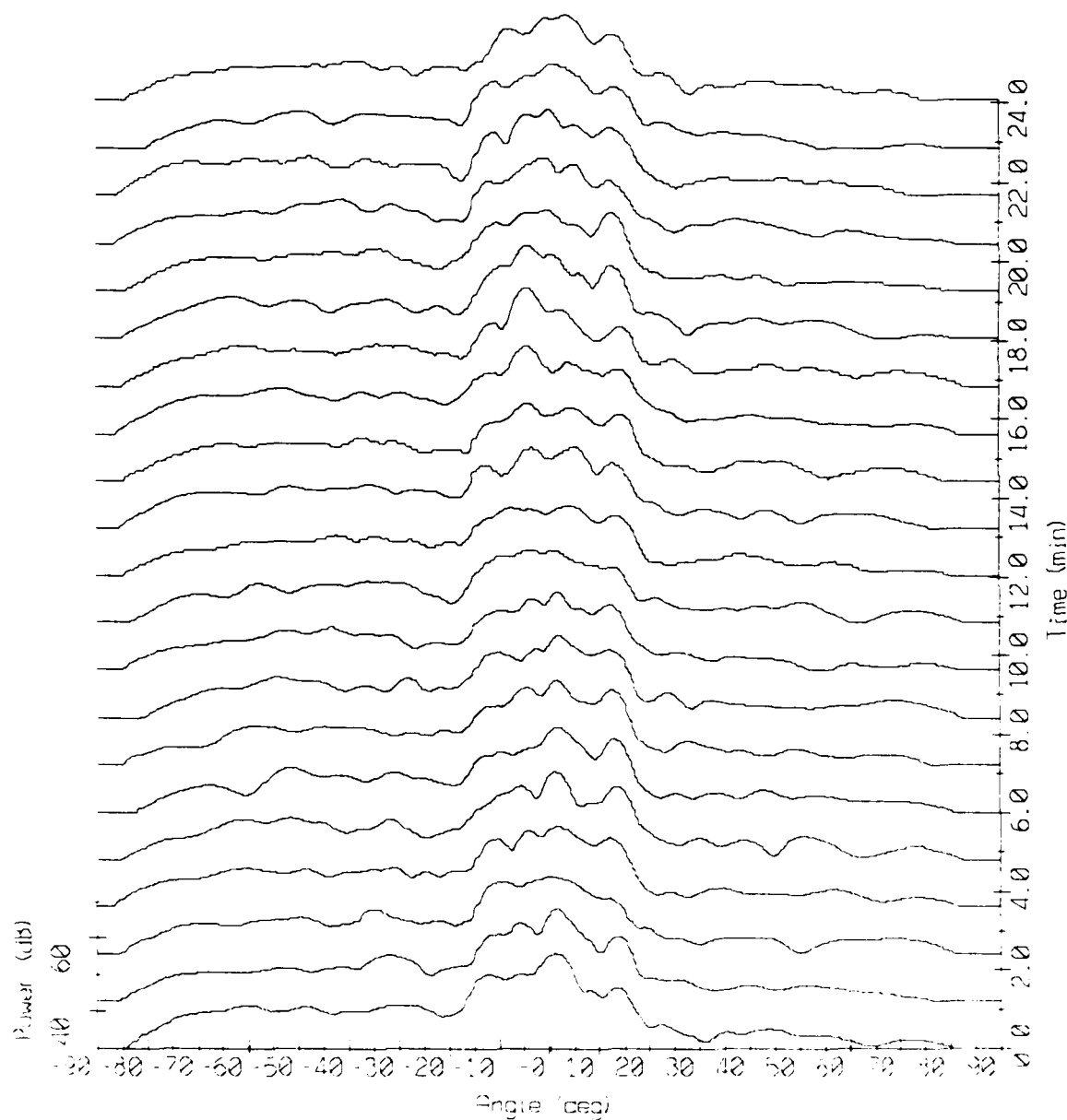
Array Response - 85010 Bin #6349  
 $f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



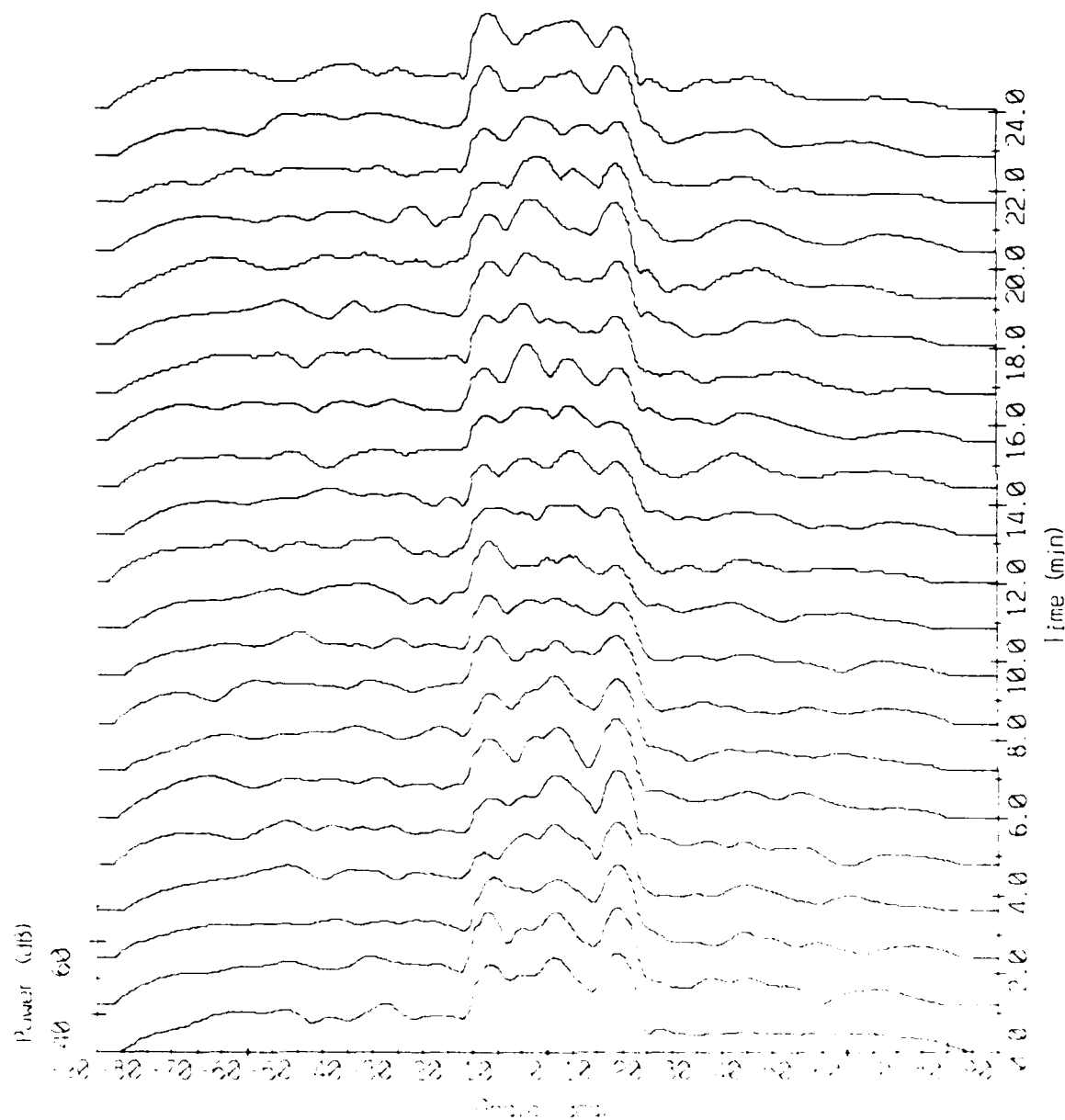
Array Response - 85010 Bin #6354  
 $f = 250.10$  Hz, KB window ( $\alpha = 1.5$ )



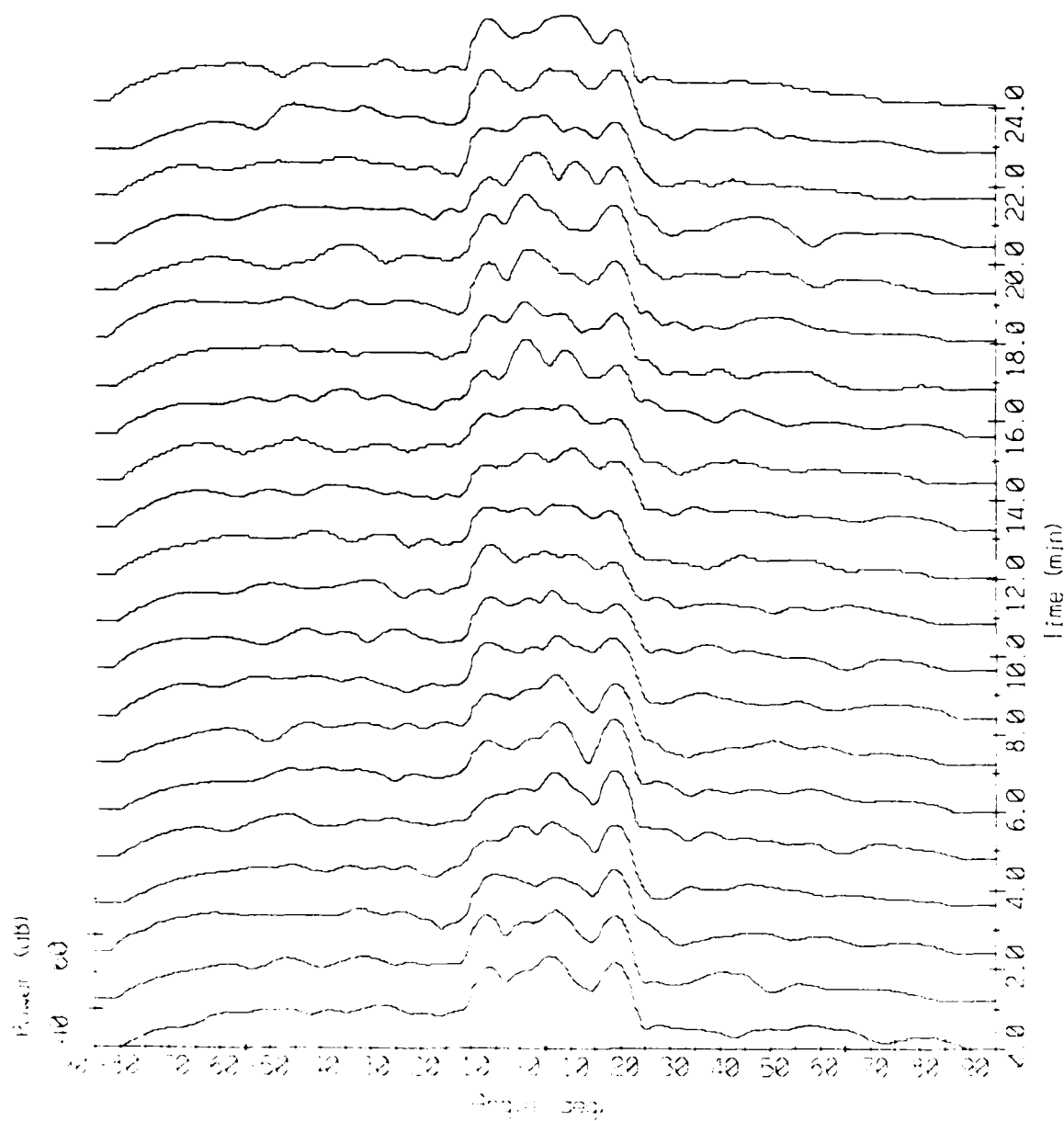
Array Response - 85010 Bin #6388  
 $f = 253.87$  Hz, KB window ( $\alpha = 1.5$ )



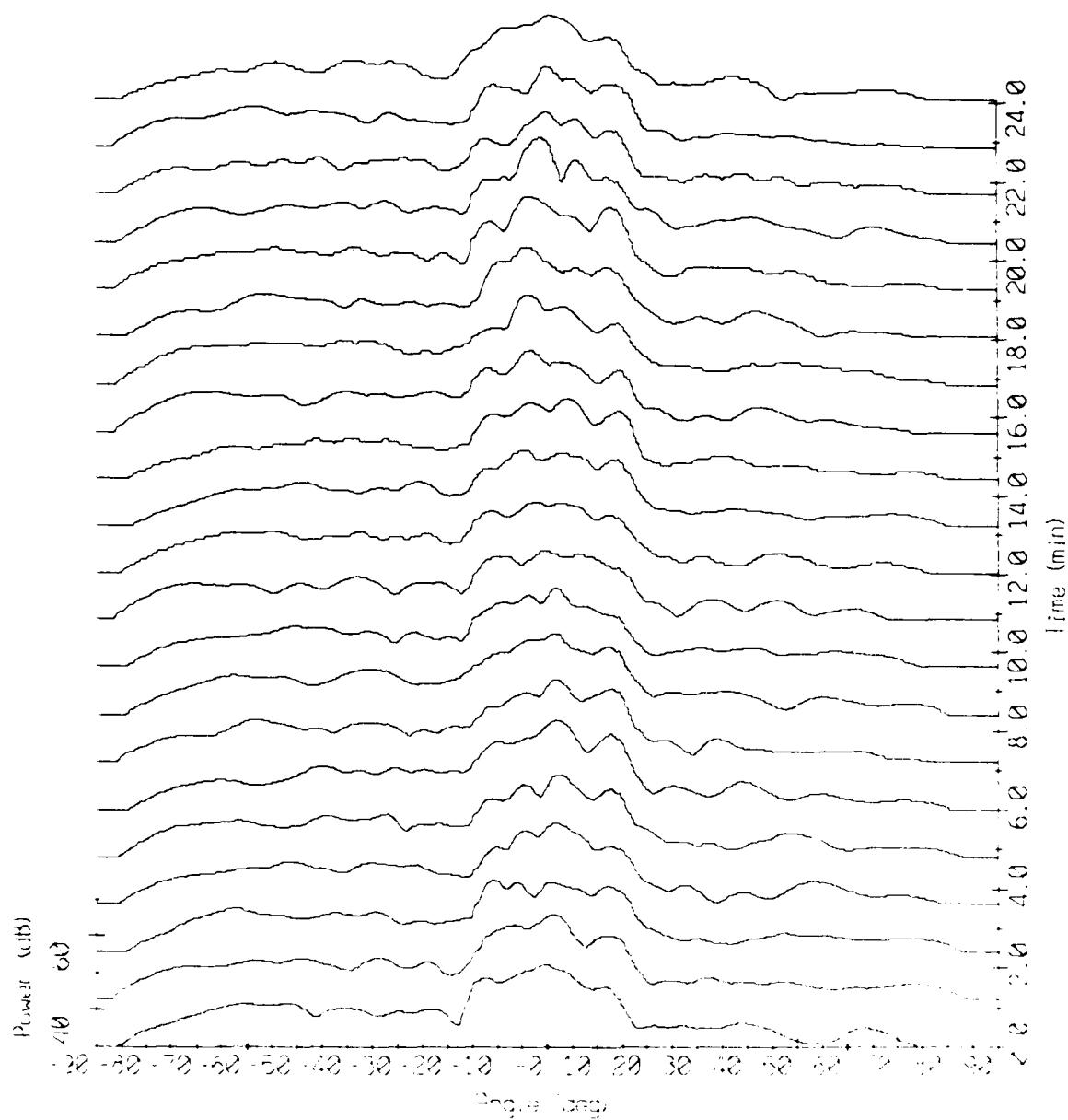
Array Response - 85010 Bin #6393  
 $f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 85010 Bin #6394  
 $f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



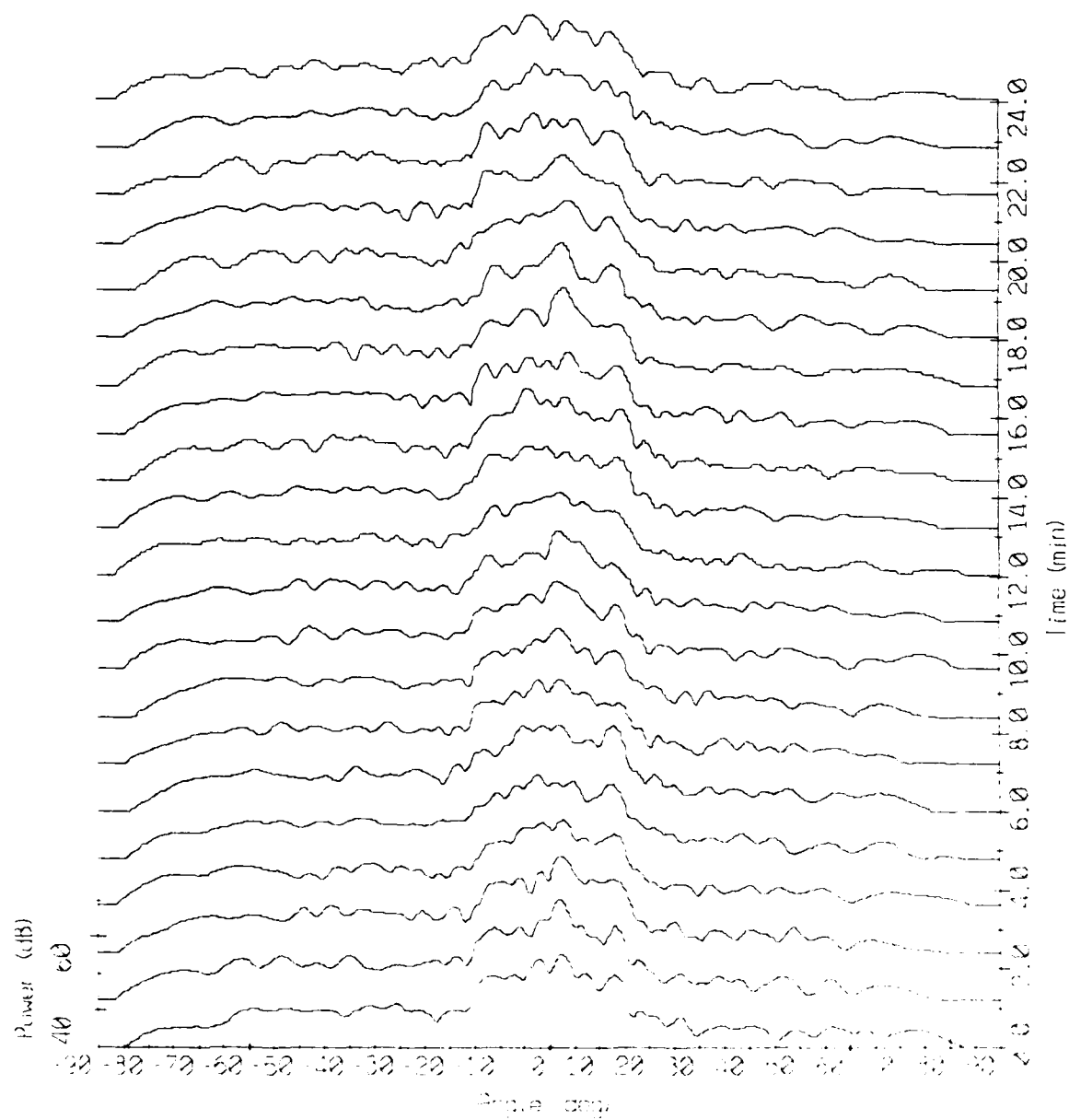
Array Response - 85010 Bin #6399  
 $f = 255.09$  Hz, KB window ( $\alpha = 1.5$ )



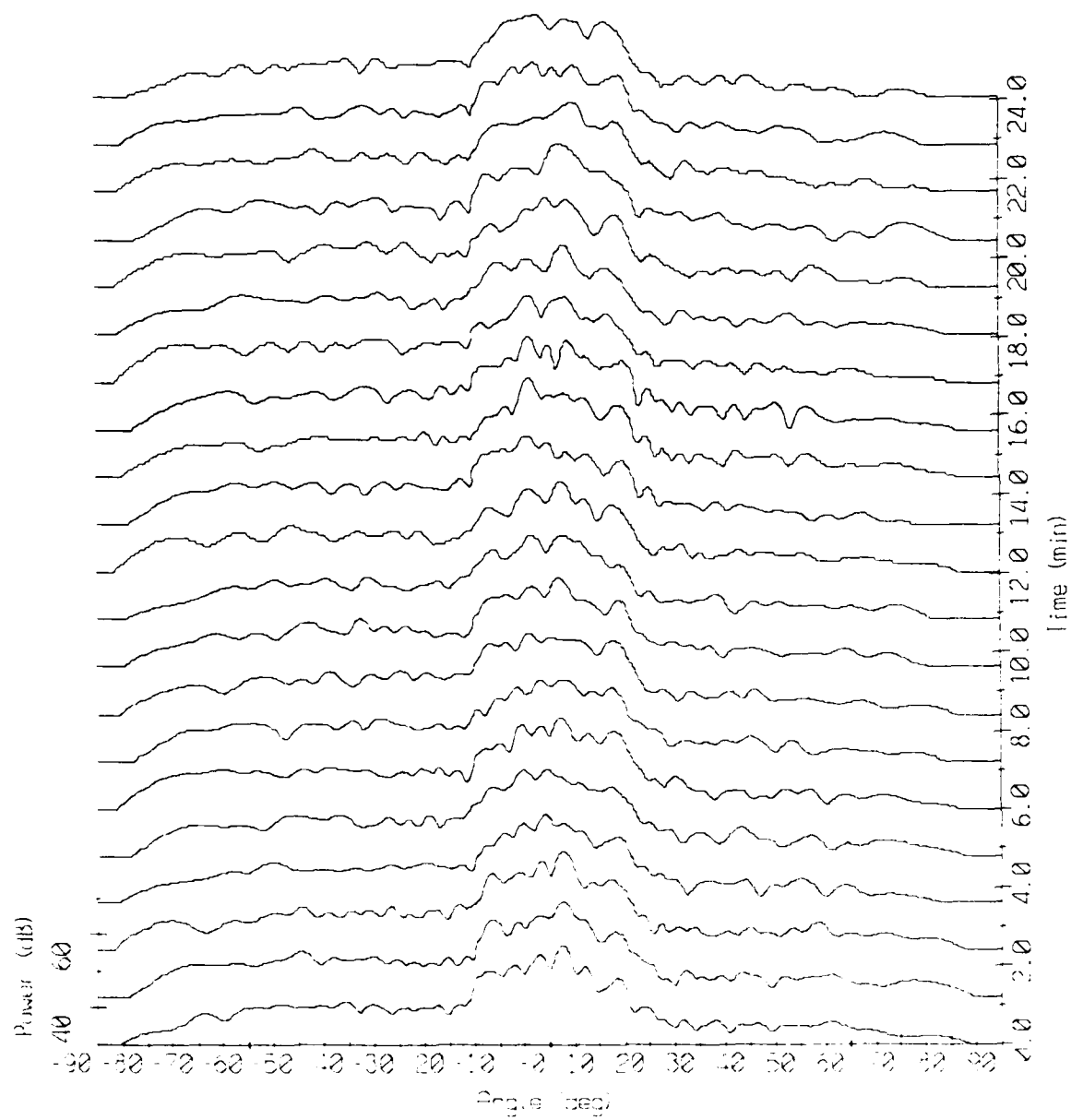
IV. Tape #85010.

D. Array Response: Waterfall, Rect Window.

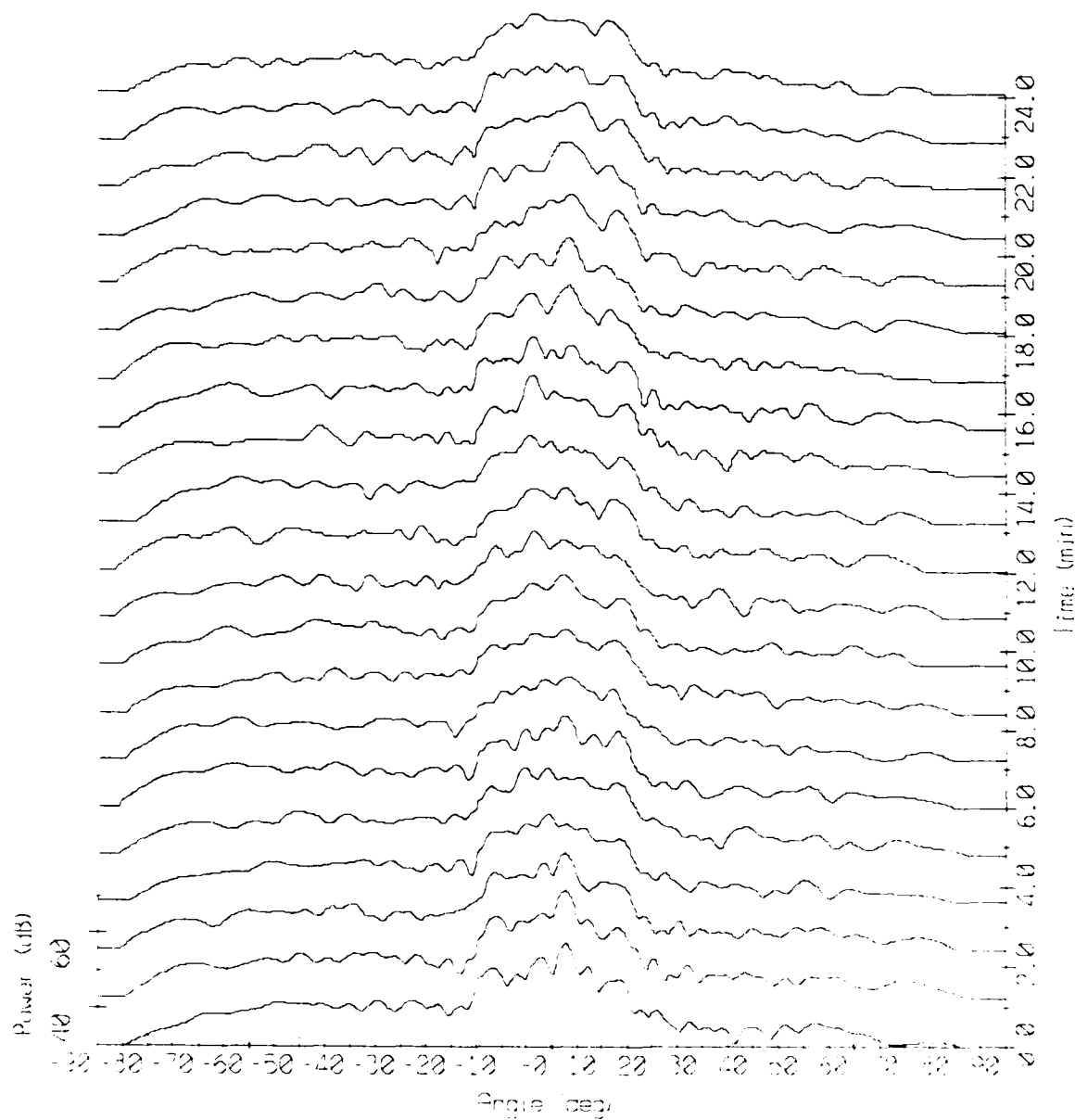
Array Response - 85010 Bin #6298  
 $f = 243.90$  Hz, rect window



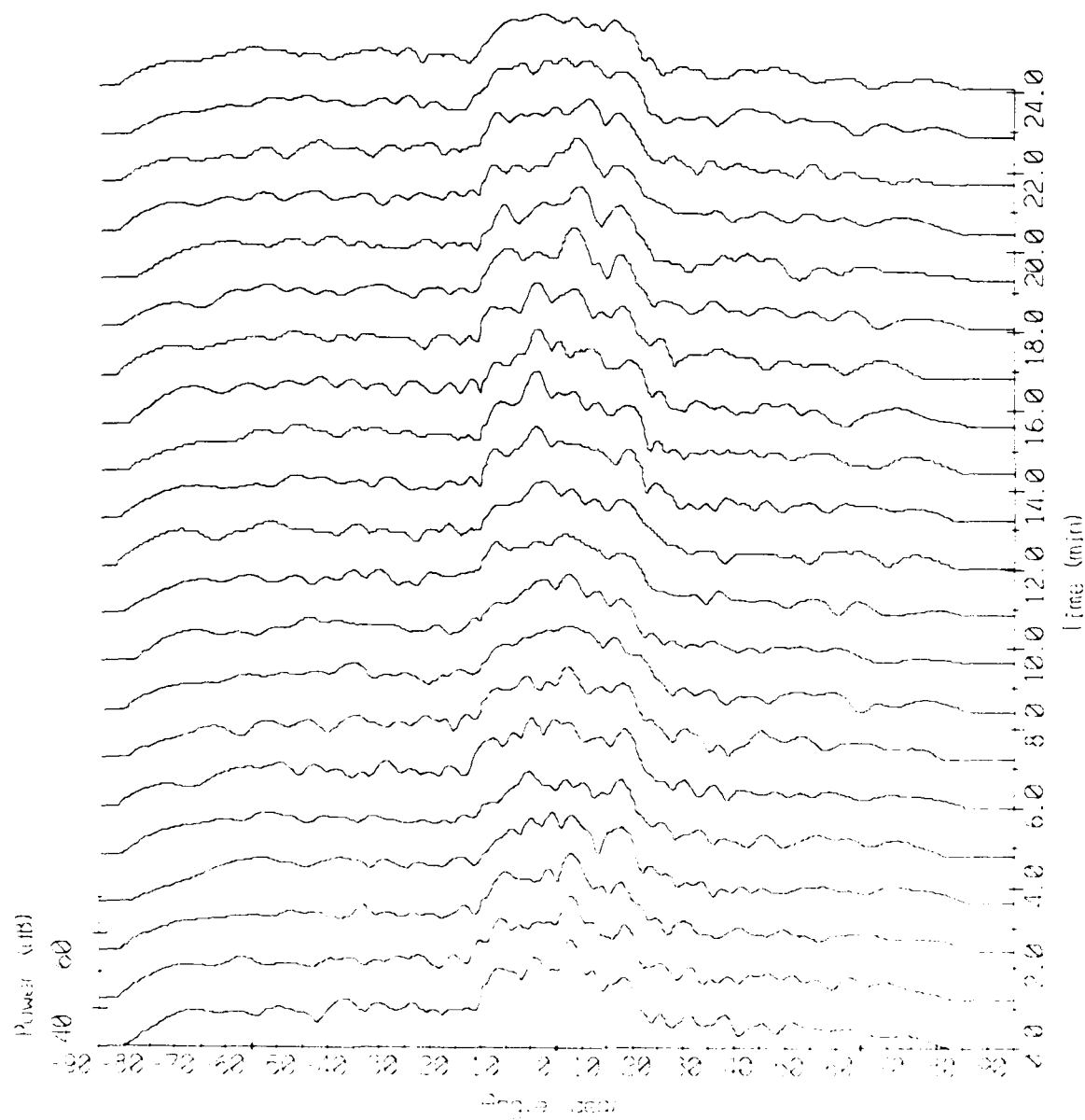
Array Response - 85010 Bin #6303  
 $f = 244.45$  Hz, rect window



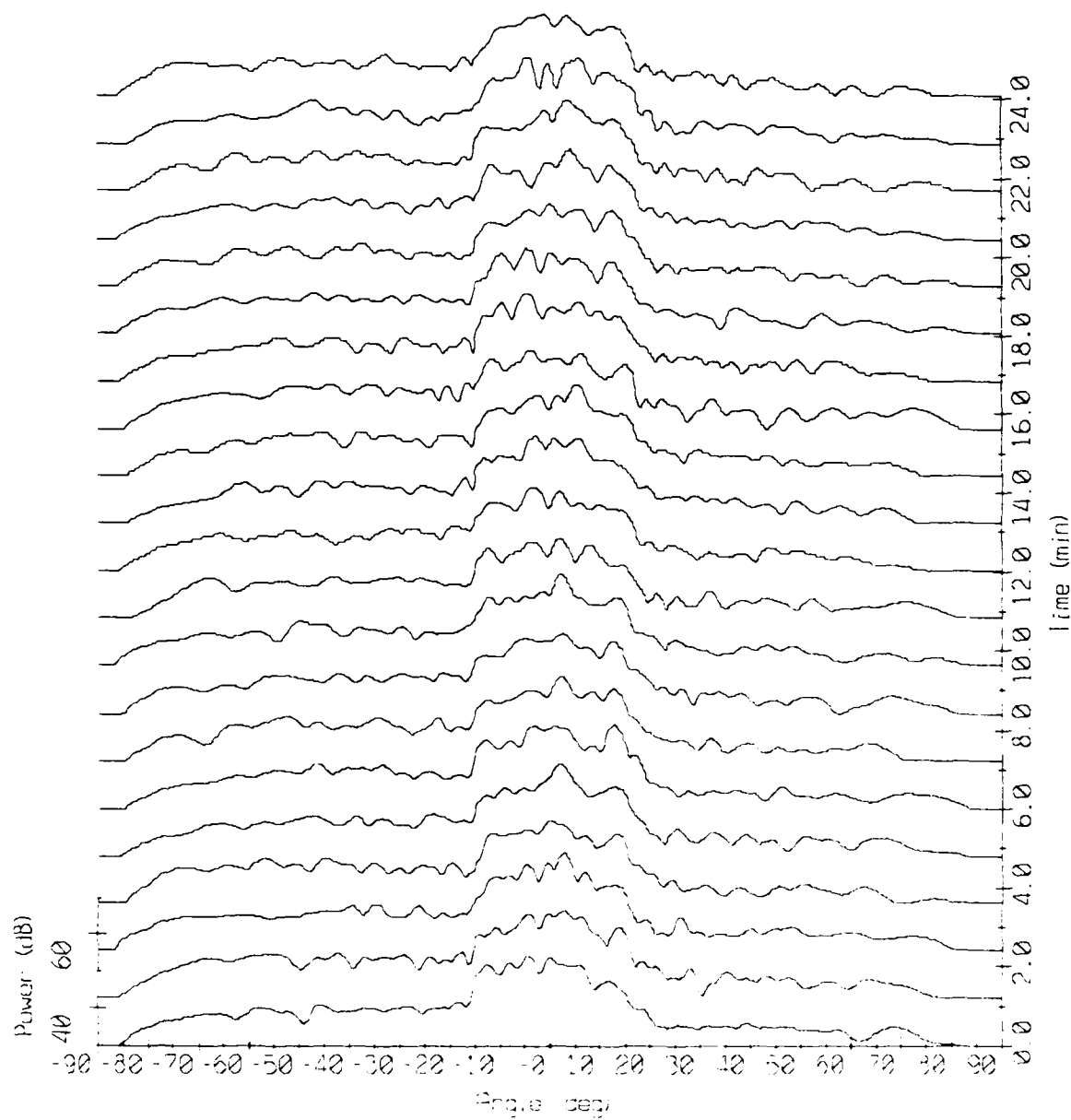
Array Response - 85010 Bin #6304  
 $f = 244.45$  Hz, rect window



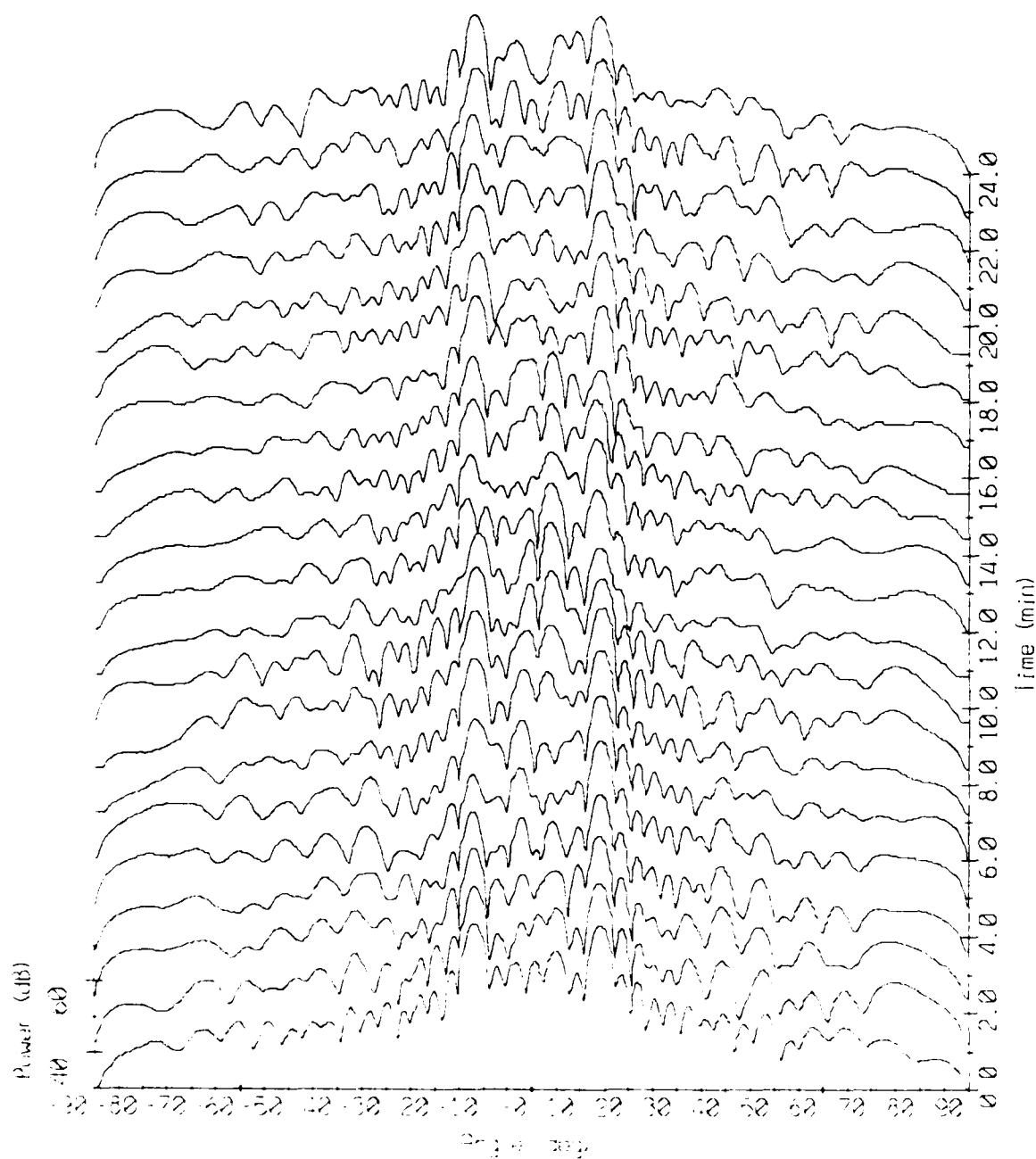
Array Response - 85010 Bin #6309  
 $f = 245.12$  Hz, rect window



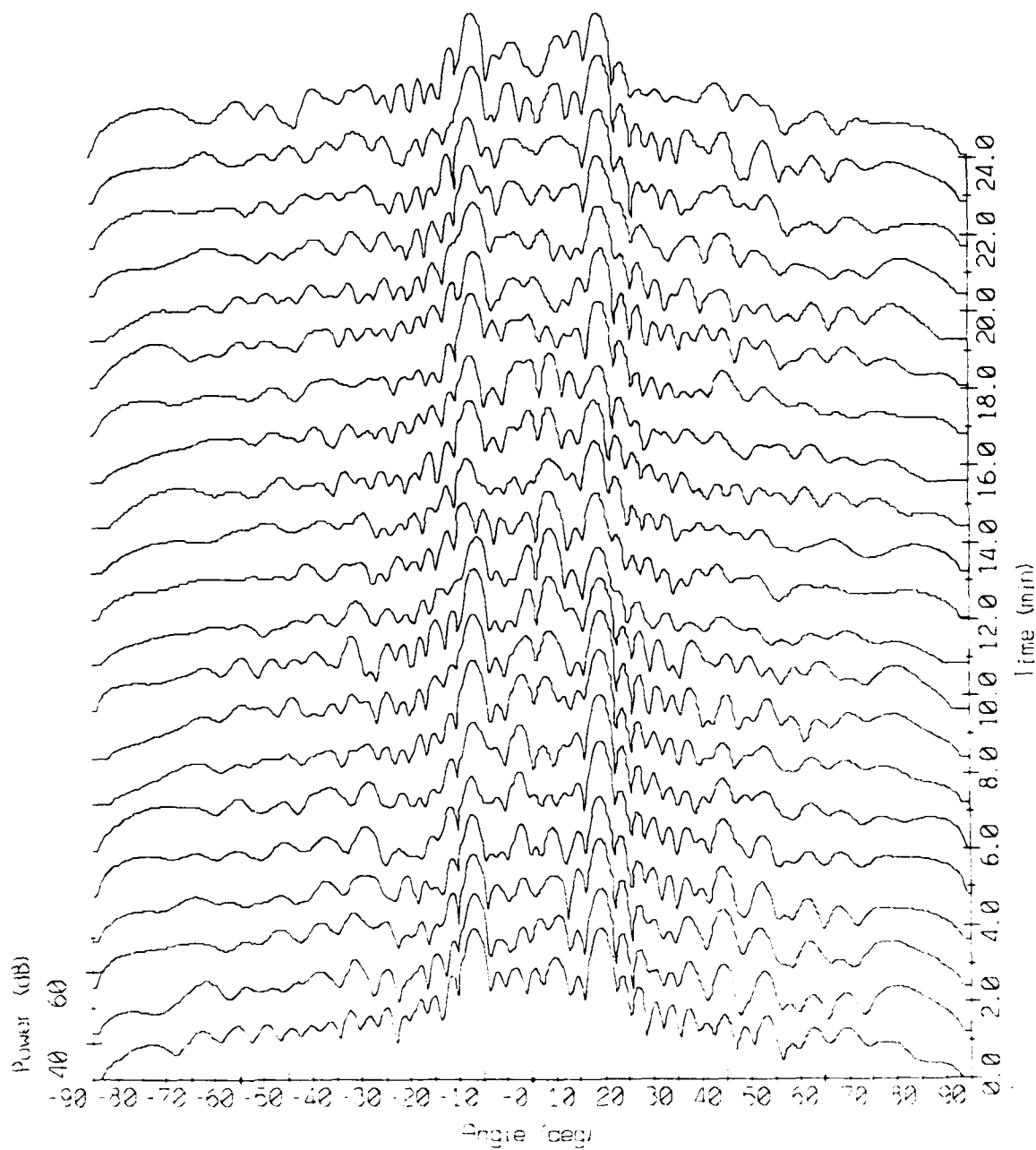
Array Response - 85010 Bin #6343  
 $f = 248.88$  Hz, rect window



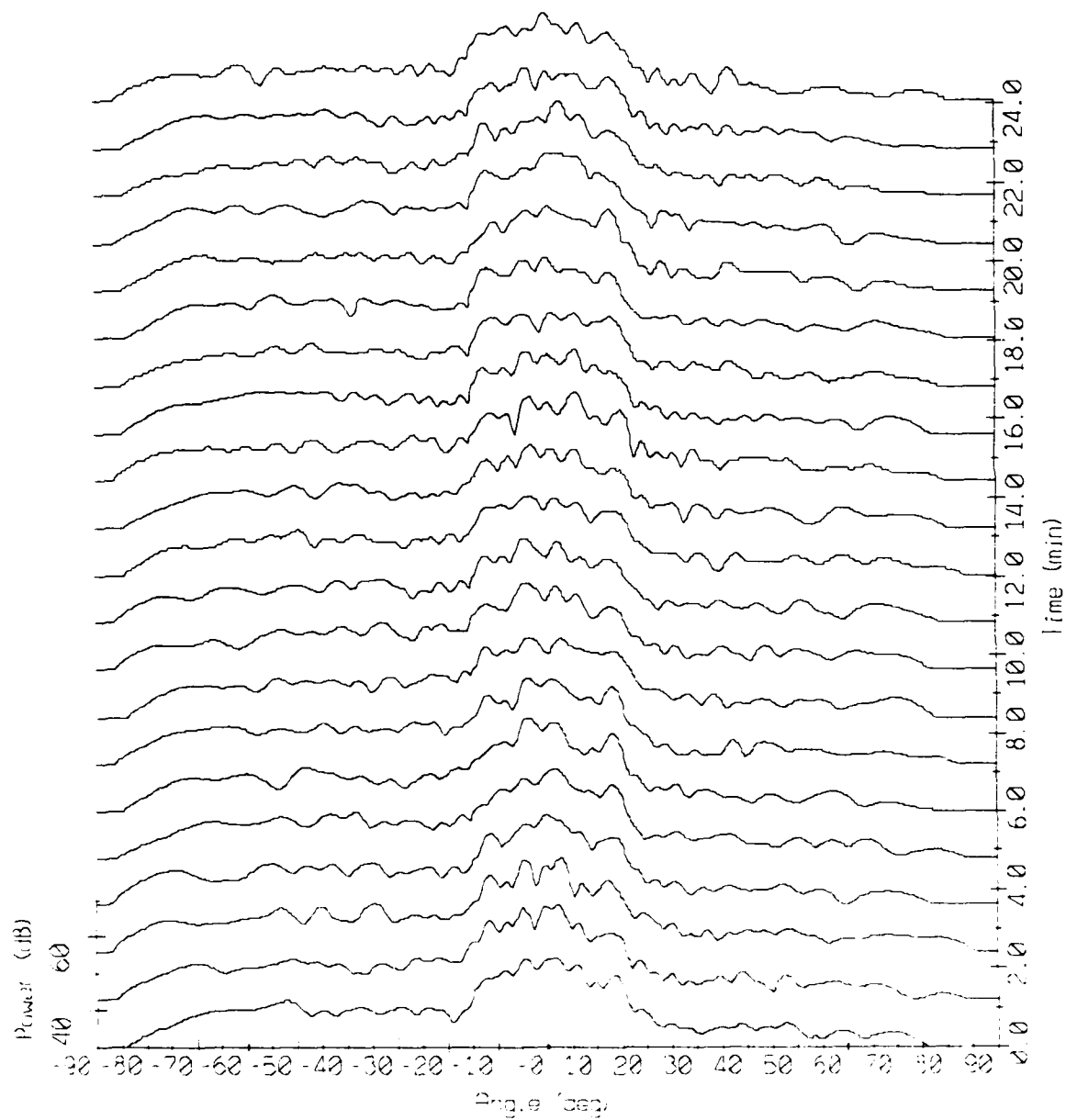
Array Response - 85010 Bin #6348  
 $f = 249.44$  Hz, rect window



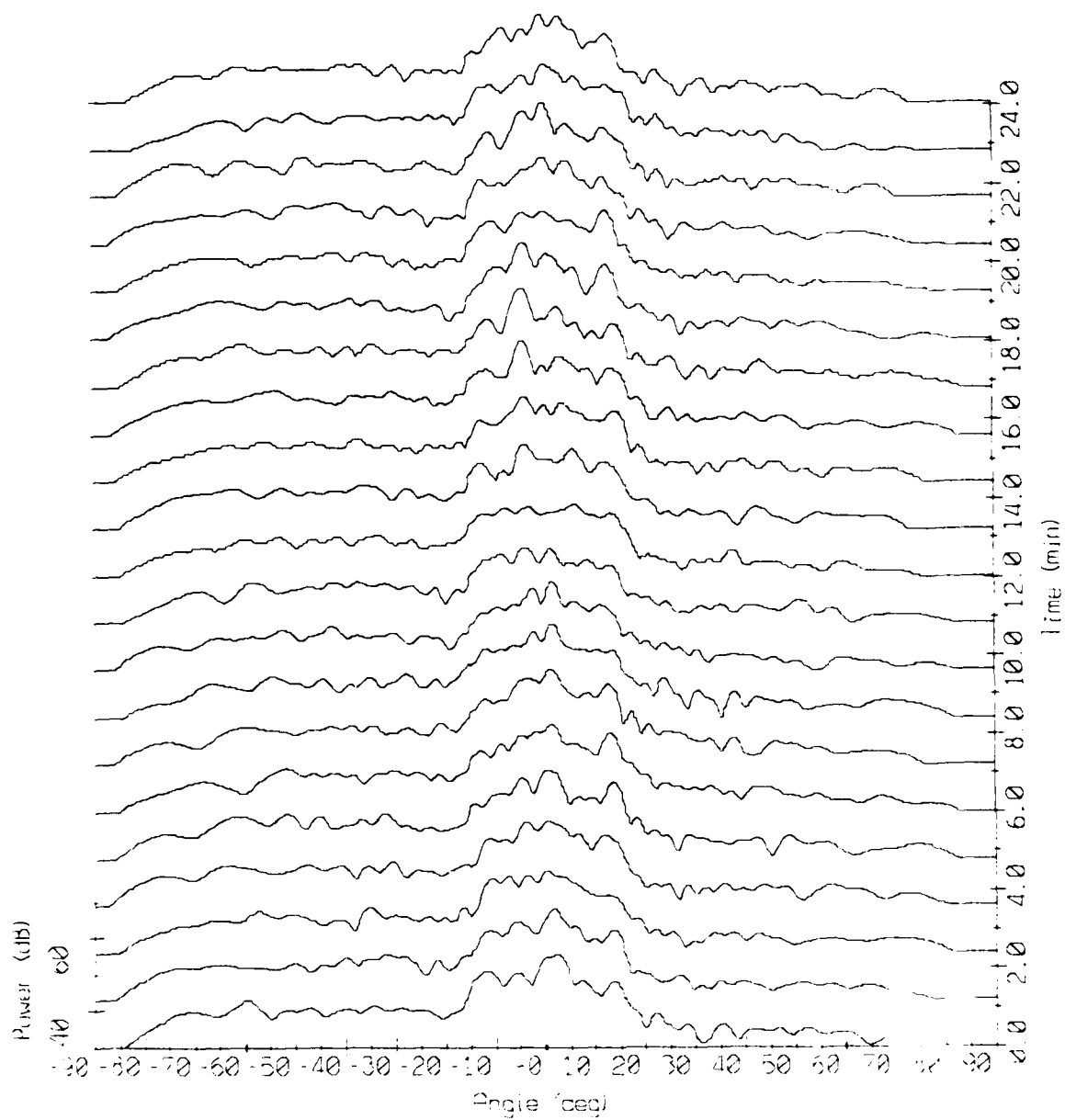
Array Response - 85010 Bin #6349  
 $f = 249.44$  Hz, rect window



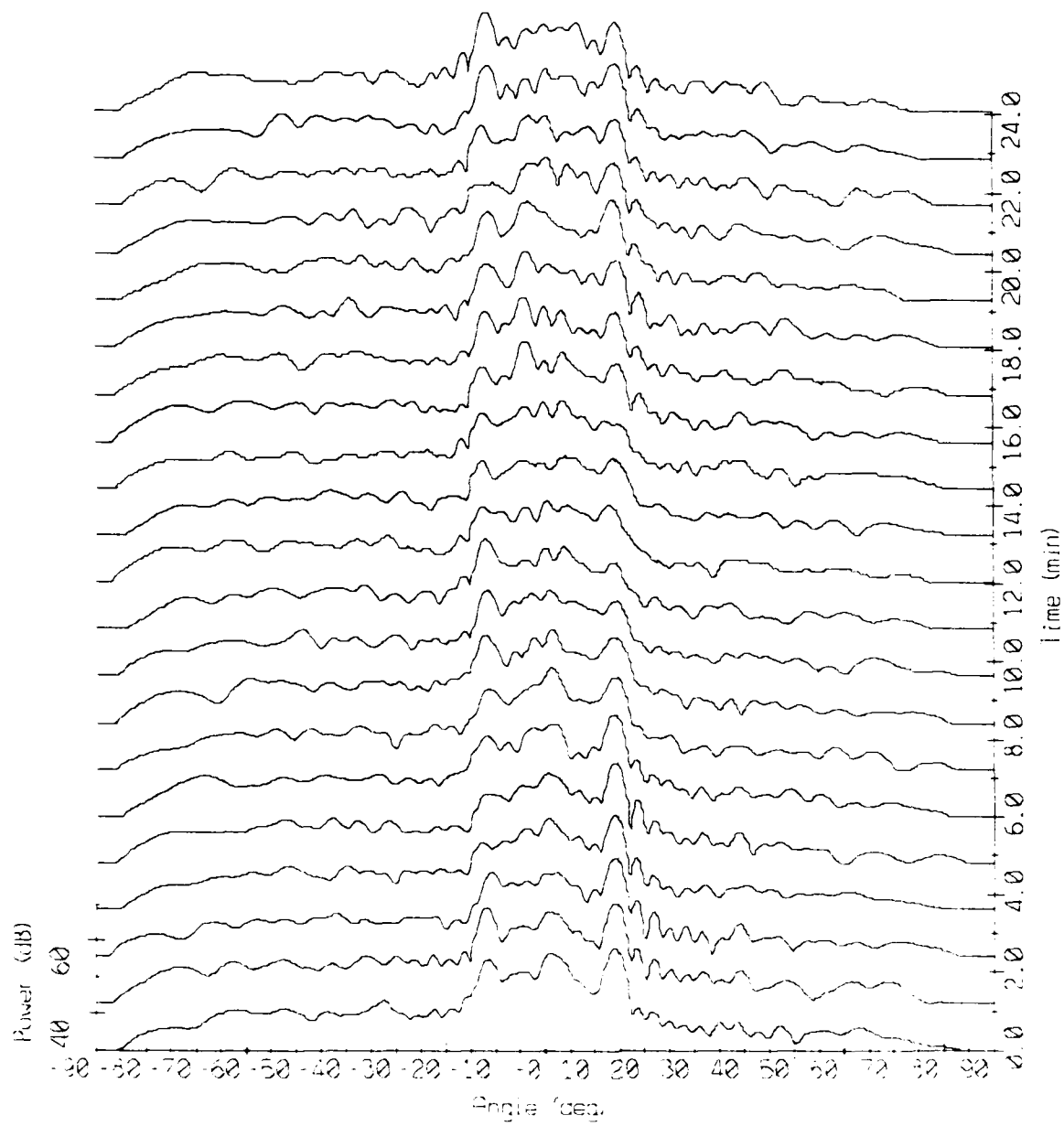
Array Response - 85010 Bin #6354  
 $f = 250.10$  Hz, rect window



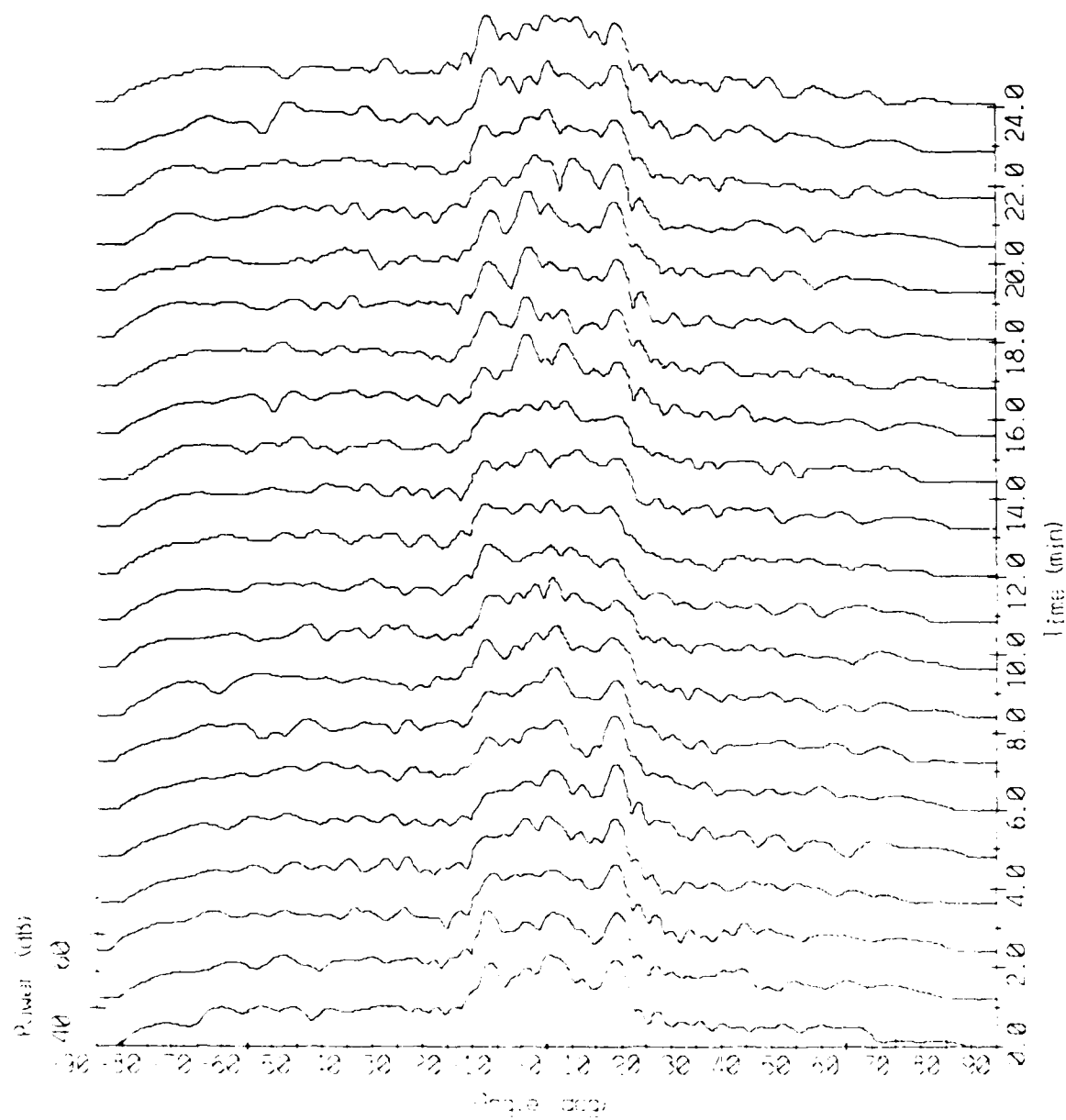
Array Response - 85010 Bin #6388  
 $f = 253.87$  Hz, rect window



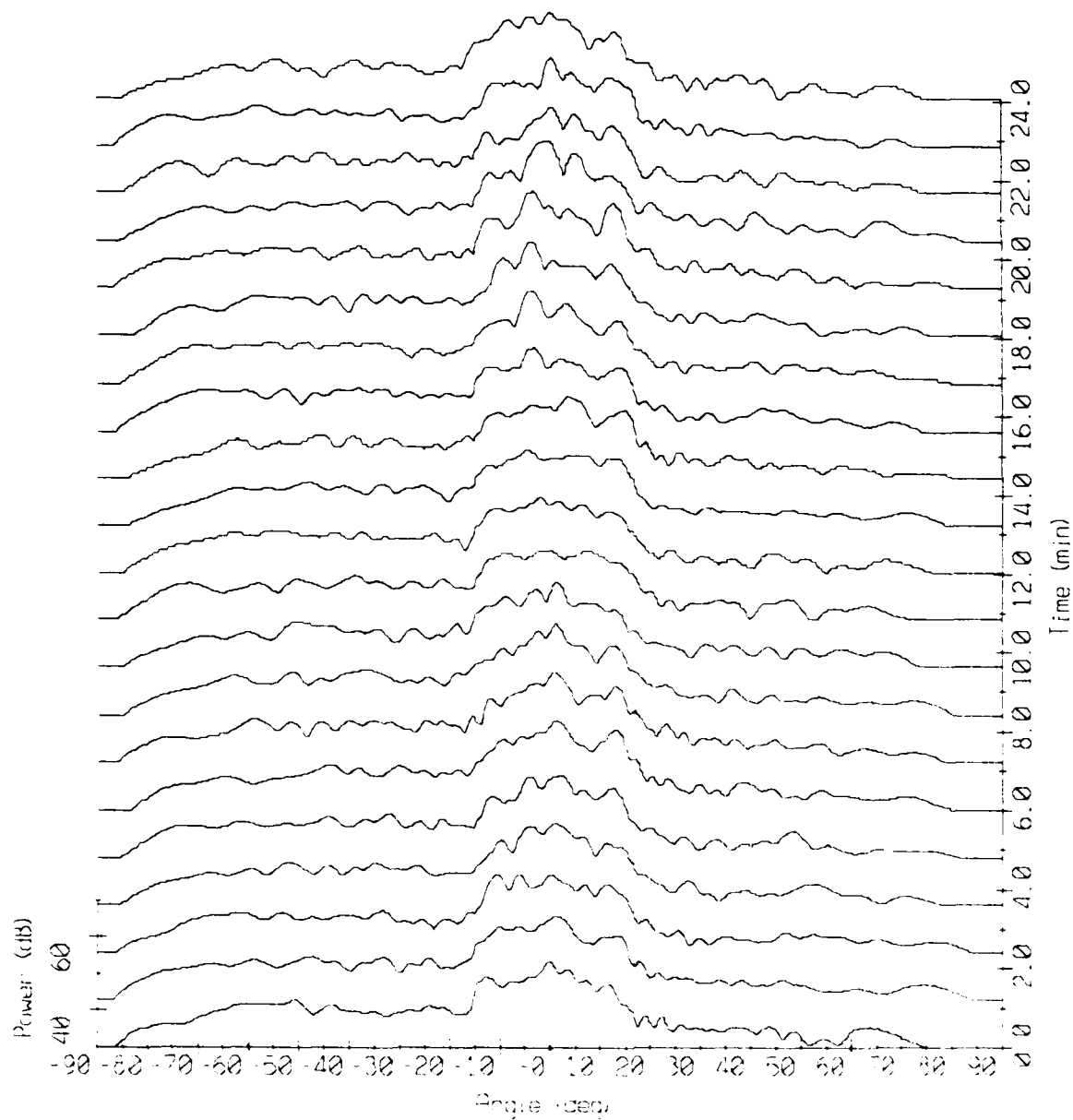
Array Response - 85010 Bin #6393  
 $f = 254.42$  Hz, next window



Array Response - 85010 Bin #6394  
 $f = 254.42$  Hz, rect window



Array Response - 85010 Bin #6399  
 $f = 255.09$  Hz, rect window

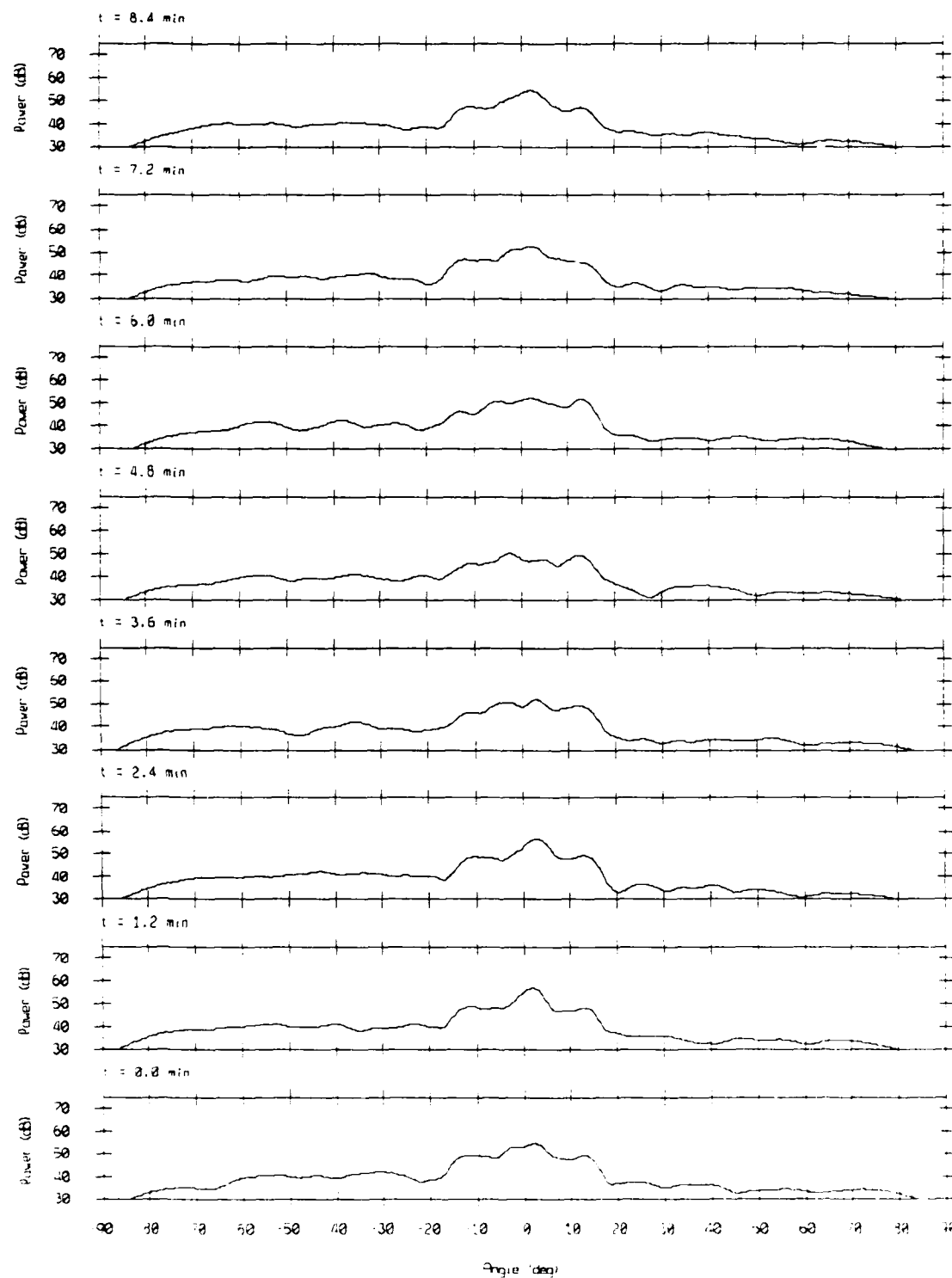


IV. Tape #85010.

E. Array Response: Panels, KB Window.

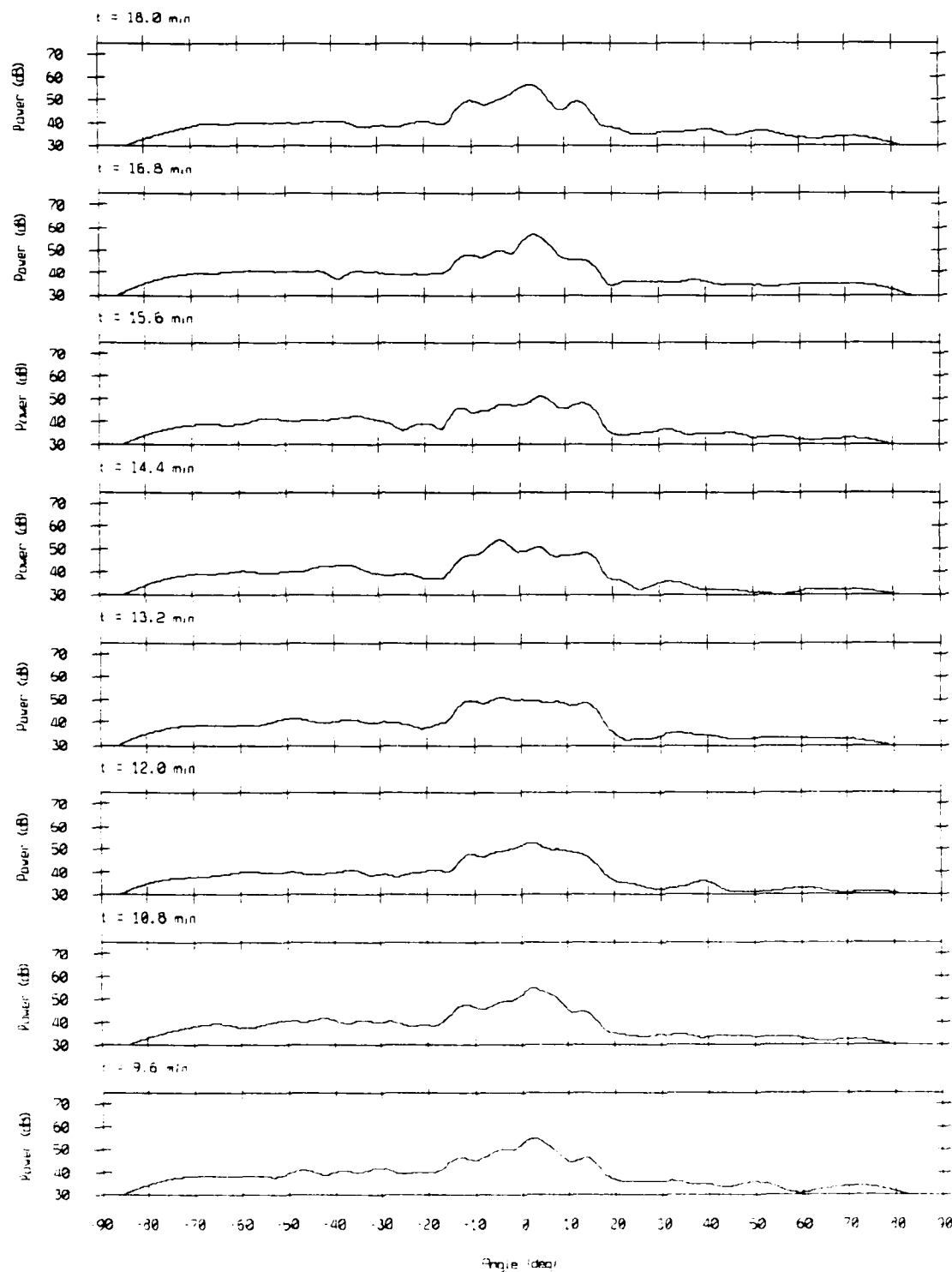
# Array Response - 85010 Bin #6298

$f = 243.90$  Hz, KB window ( $\alpha = 1.5$ )



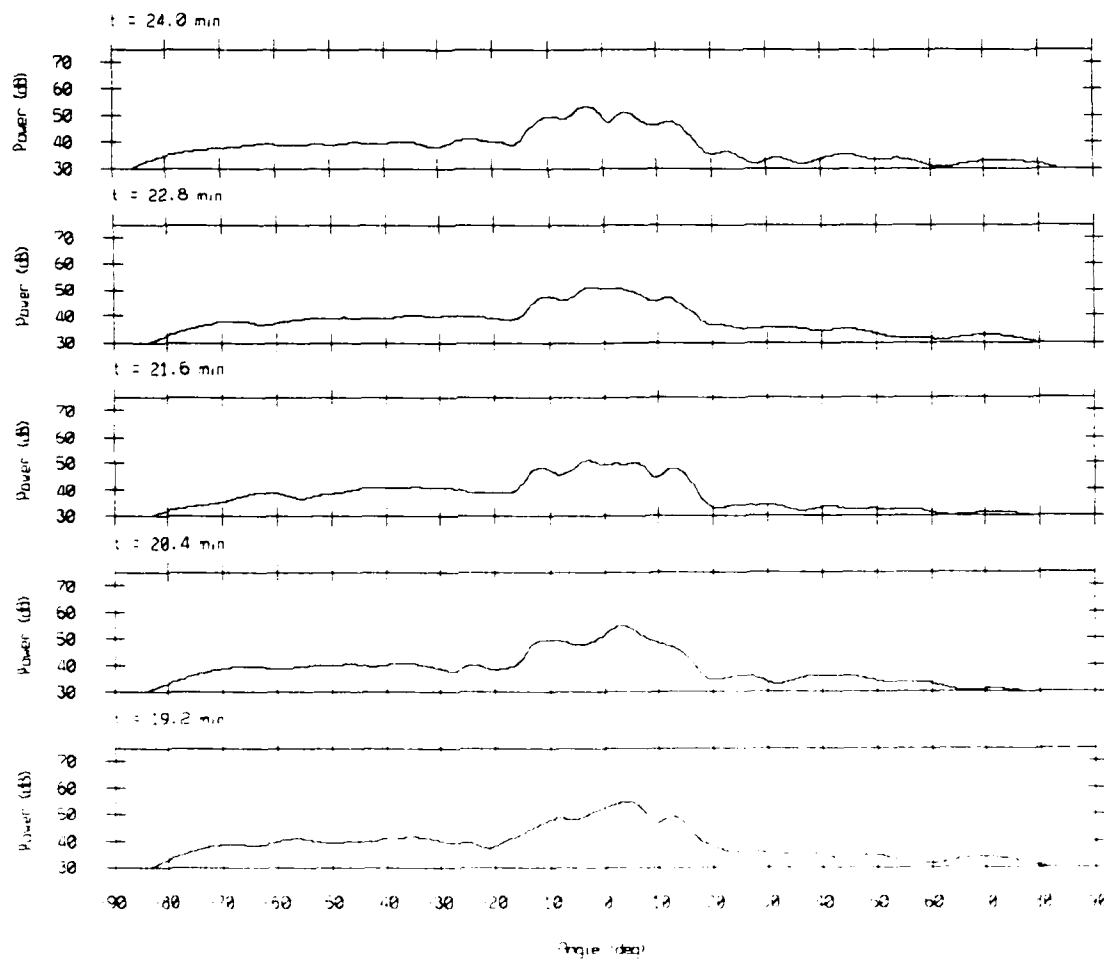
Array Response - 85010 Bin #6298

$f = 243.90$  Hz, KB window ( $\alpha = 1.5$ )



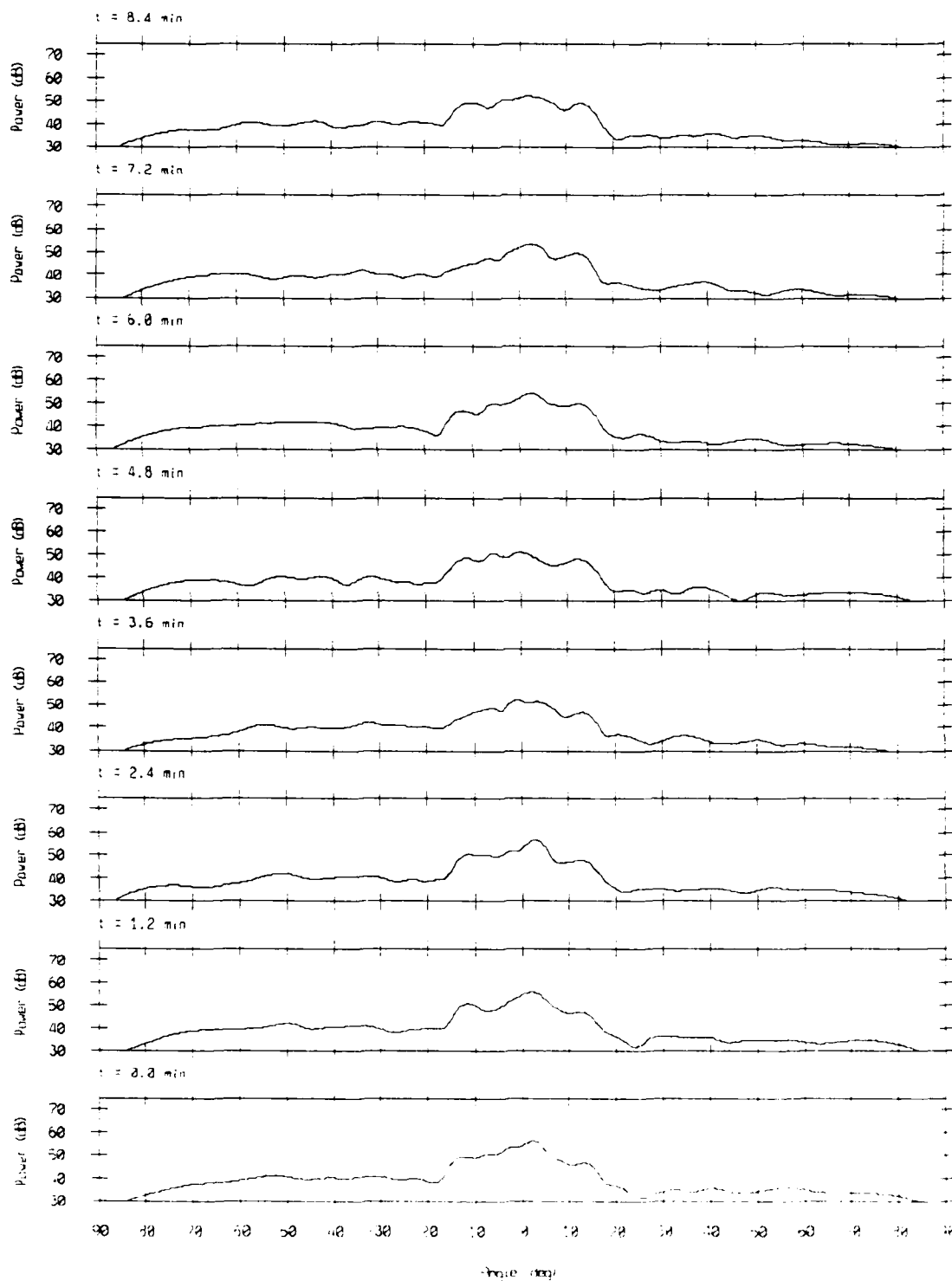
Array Response - 85010 Bin #6298

$f = 243.90$  Hz, KB window ( $\alpha = 1.5$ )



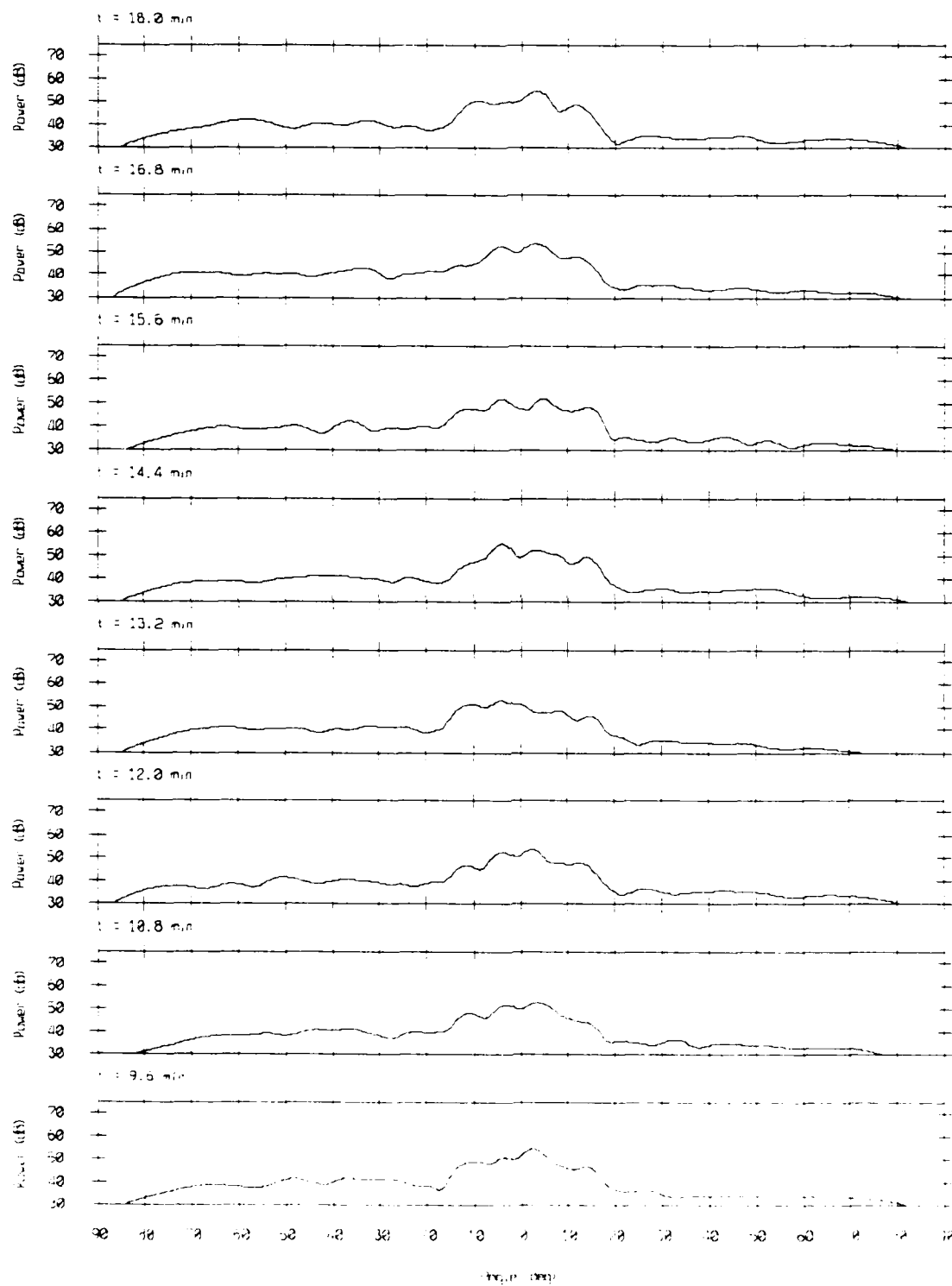
# Array Response - 85010 Bin #6303

$f = 244.45$  Hz,  $\Delta f$  window (alpha = 1.5)



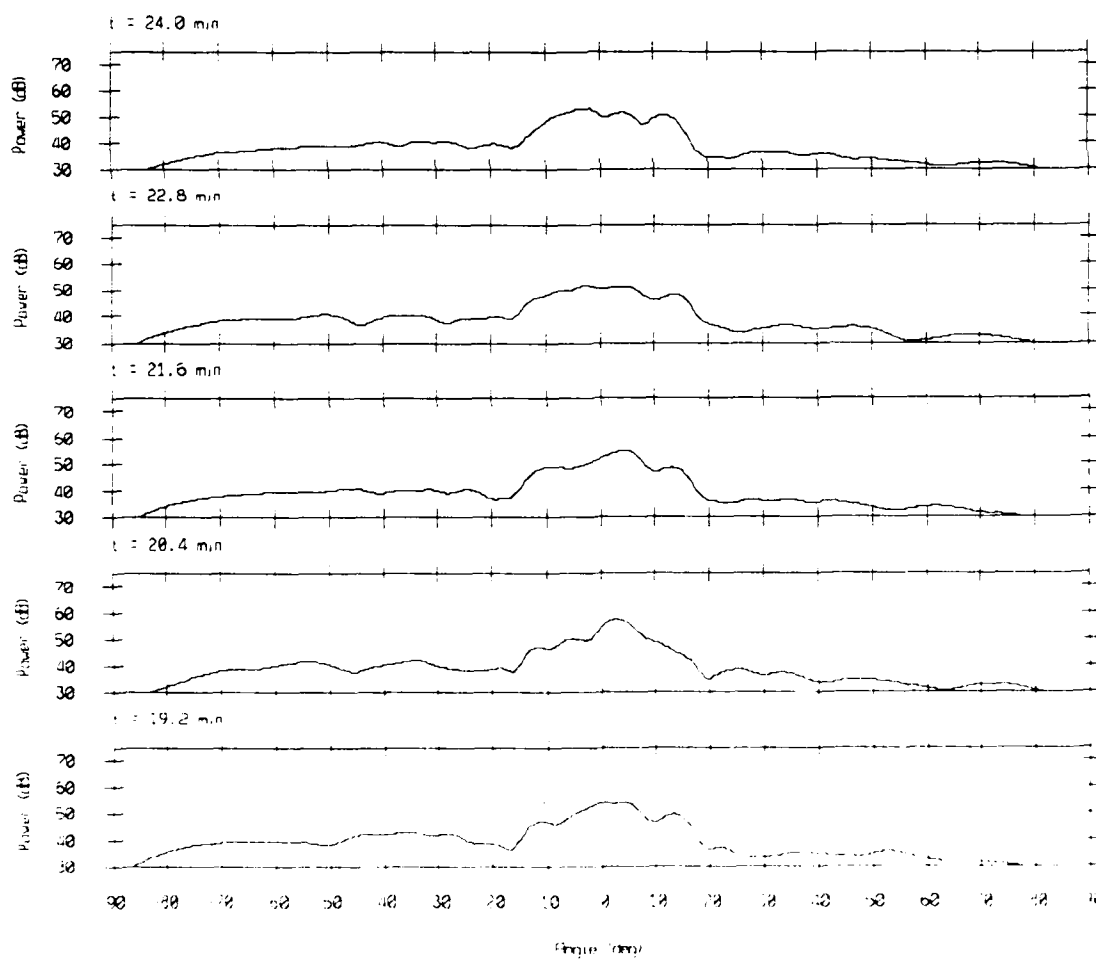
Array Response - 85010 Bin #6303

$f = 244.45$  Hz, KB window ( $\alpha = 1.5$ )



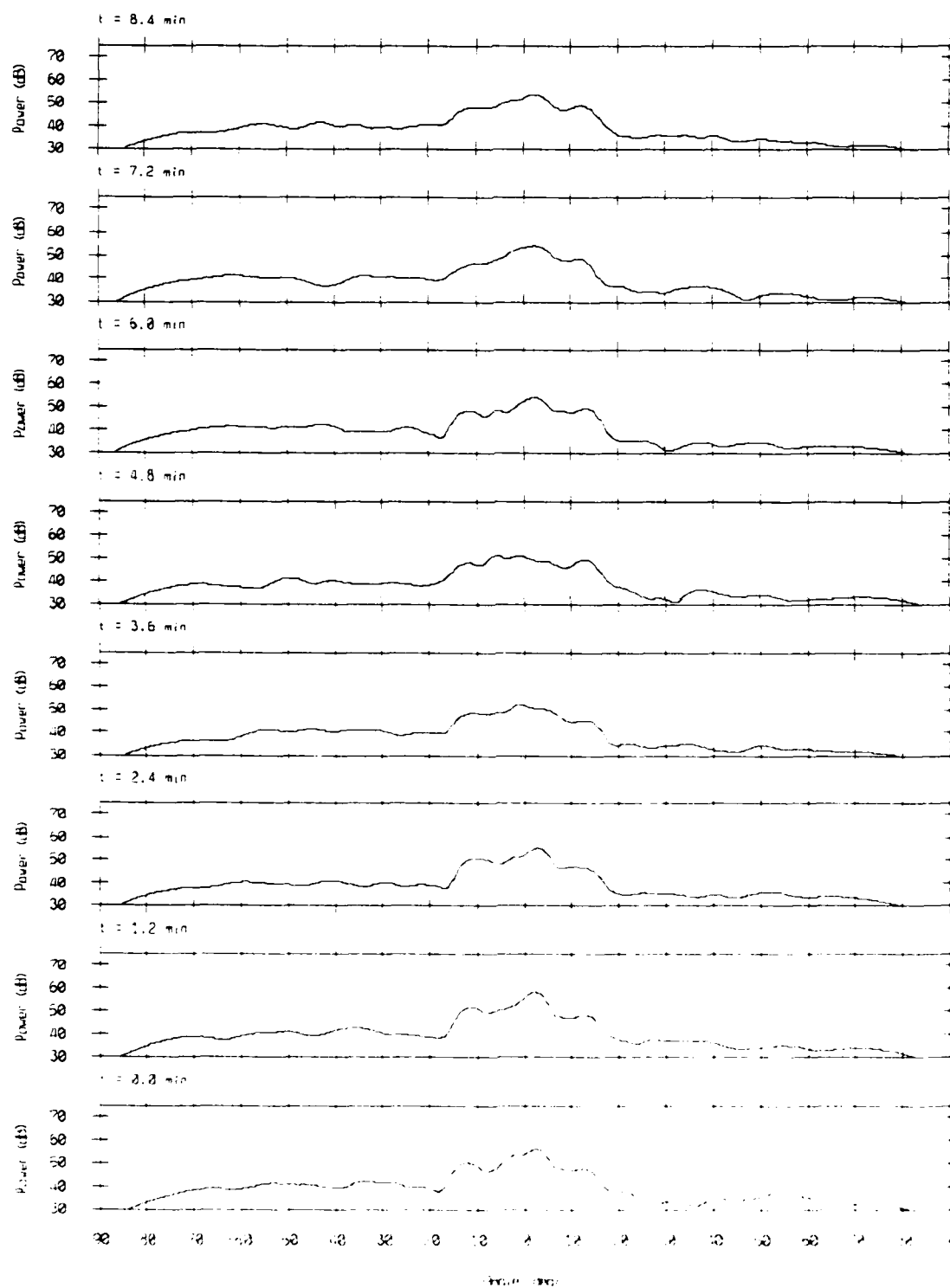
Array Response - 85010 Bin #6303

$f = 244.45$  Hz, KB window ( $\alpha = 1.5$ )



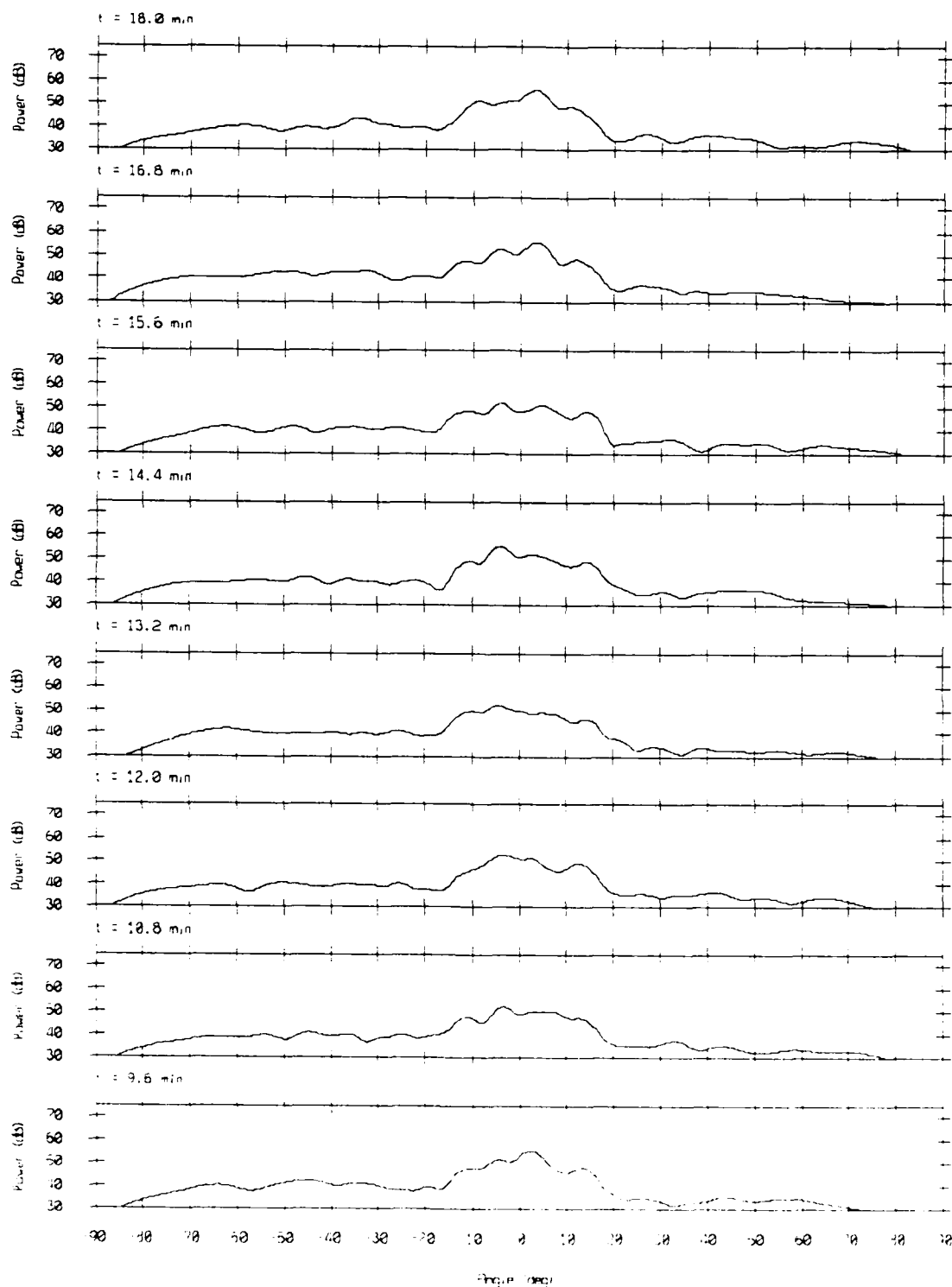
Array Response - 85010 Bin #6304

$f = 244.45$  Hz, KB window (alpha = 1.5)



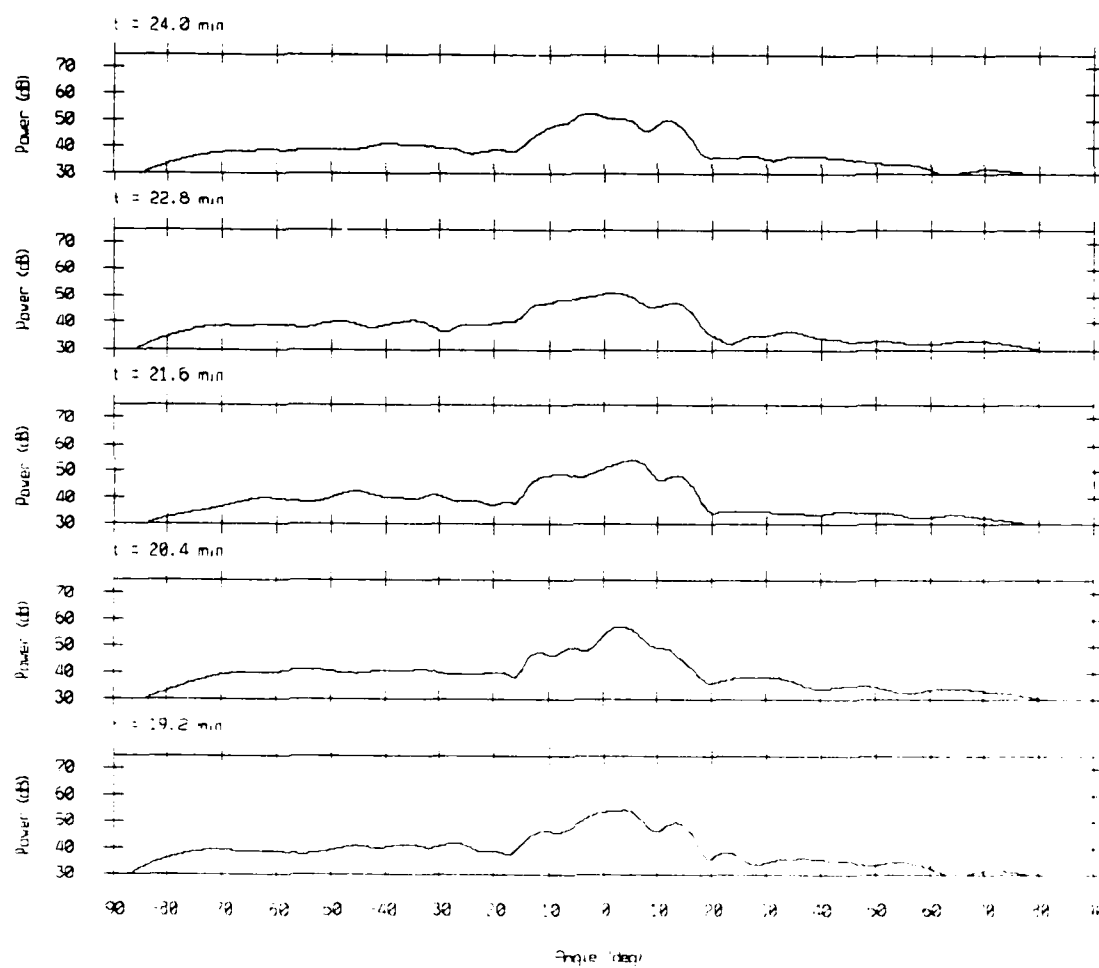
Array Response - 85010 Bin #6304

$f = 244.45$  Hz, KB window ( $\alpha = 1.5$ )



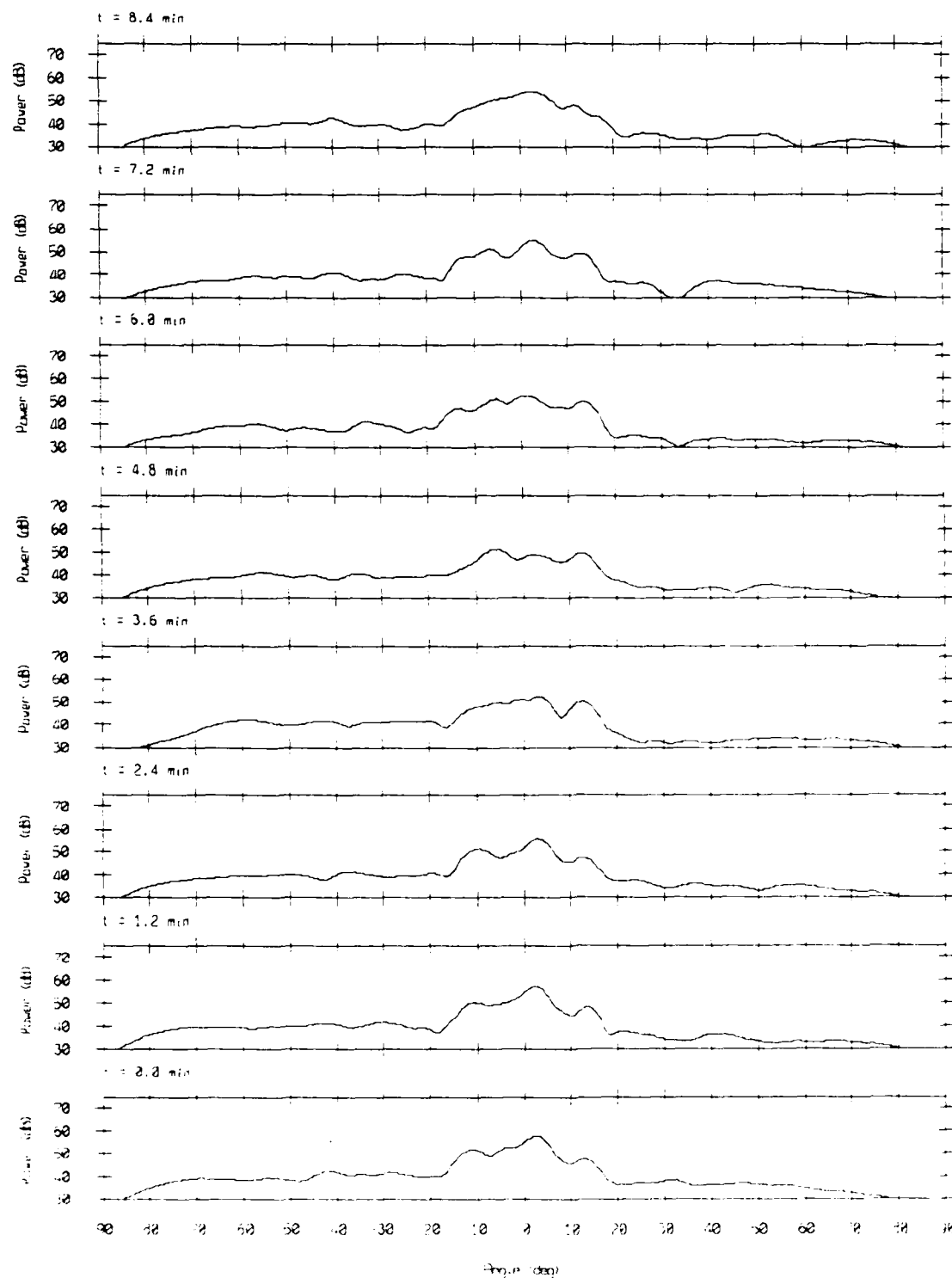
Array Response - 85010 Bin #6304

$f = 244.45$  Hz, KB window ( $\alpha = 1.5$ )



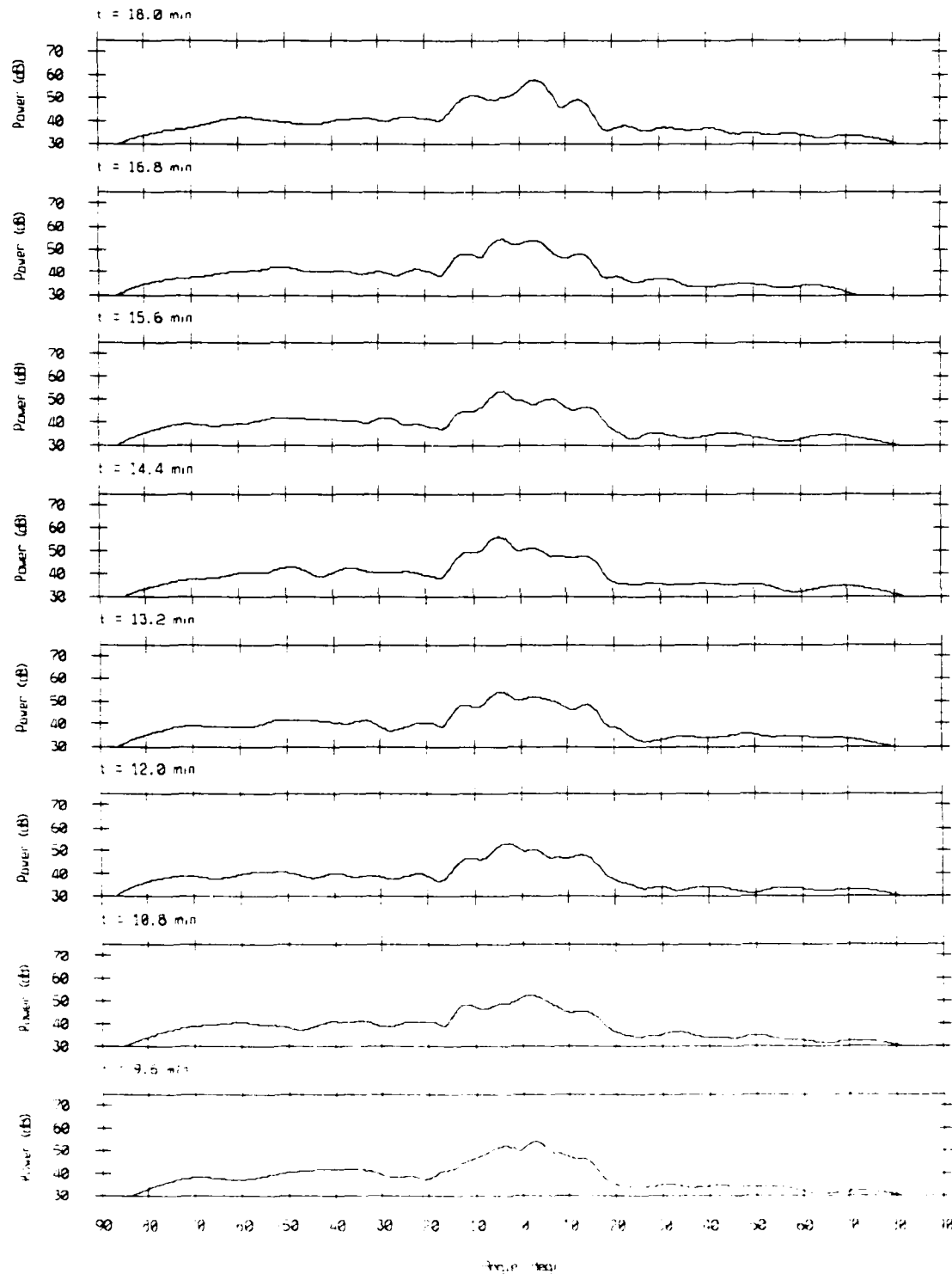
Array Response - 85010 Bin #6309

$f = 245.12$  Hz,  $\Delta B$  window ( $\alpha = 1.5$ )



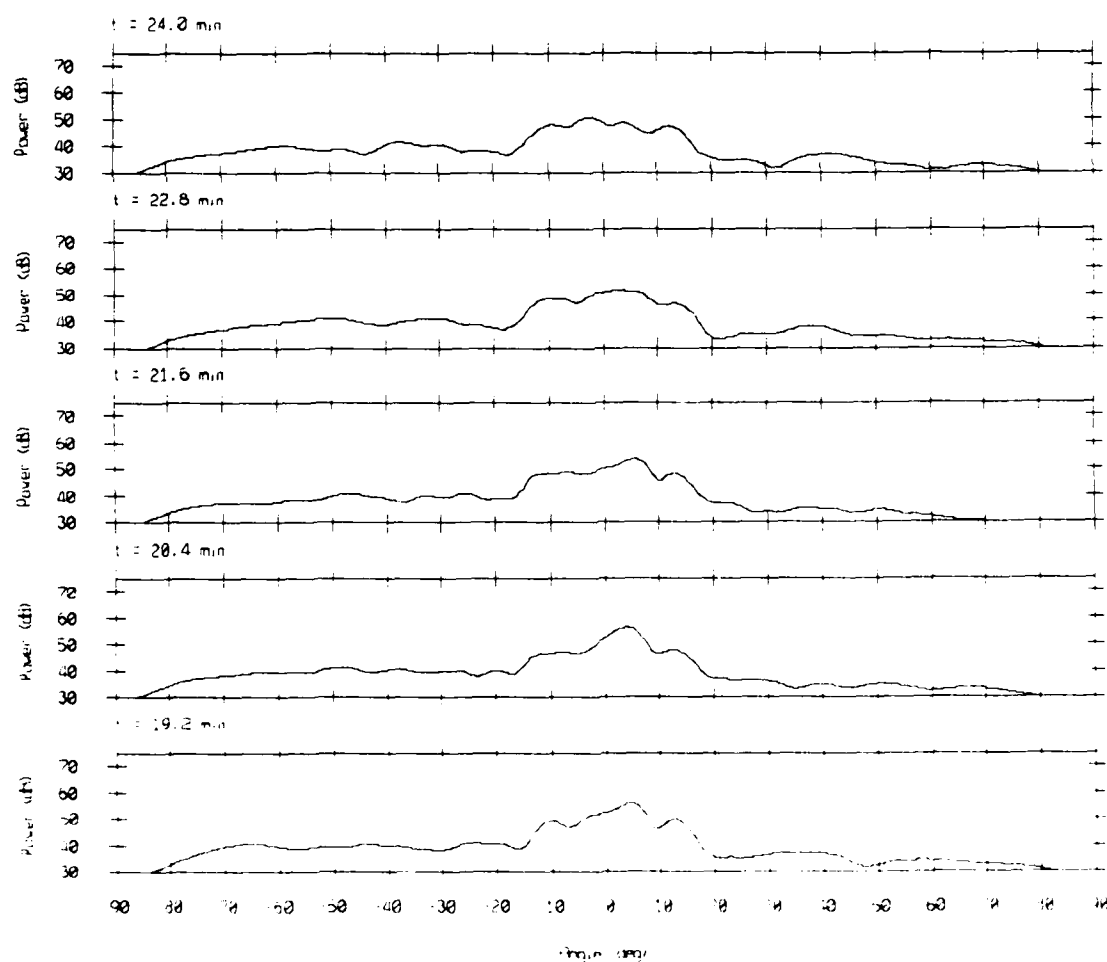
Array Response - 85010 Bin #6309

$f = 245.12$  Hz, KB window ( $\alpha = 1.5$ )



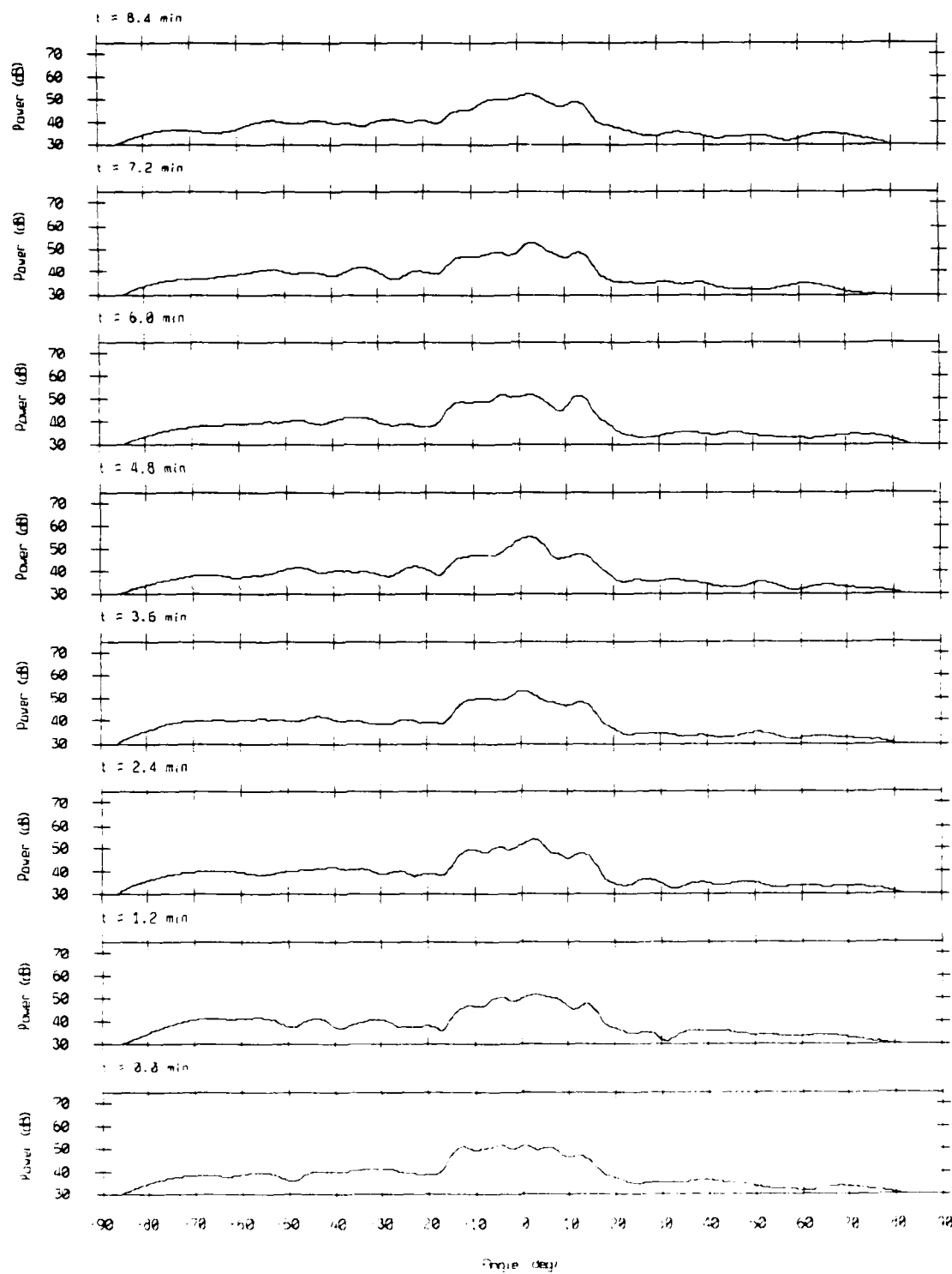
Array Response - 85010 Bin #6309

$f = 245.12$  Hz, KB window ( $\alpha = 1.5$ )



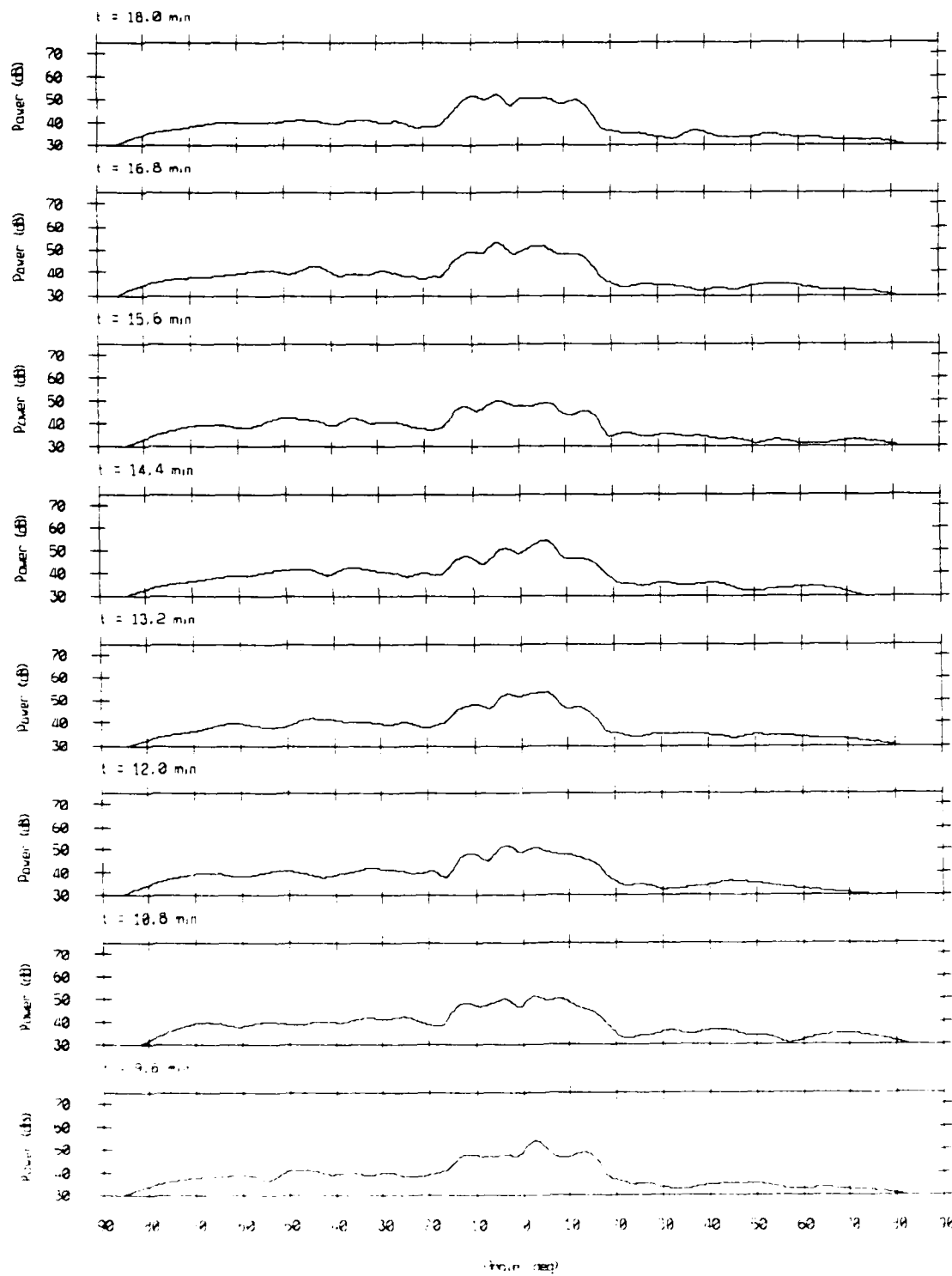
Array Response - 85010 Bin #6343

$f = 248.88$  Hz, KB window ( $\alpha = 1.5$ )



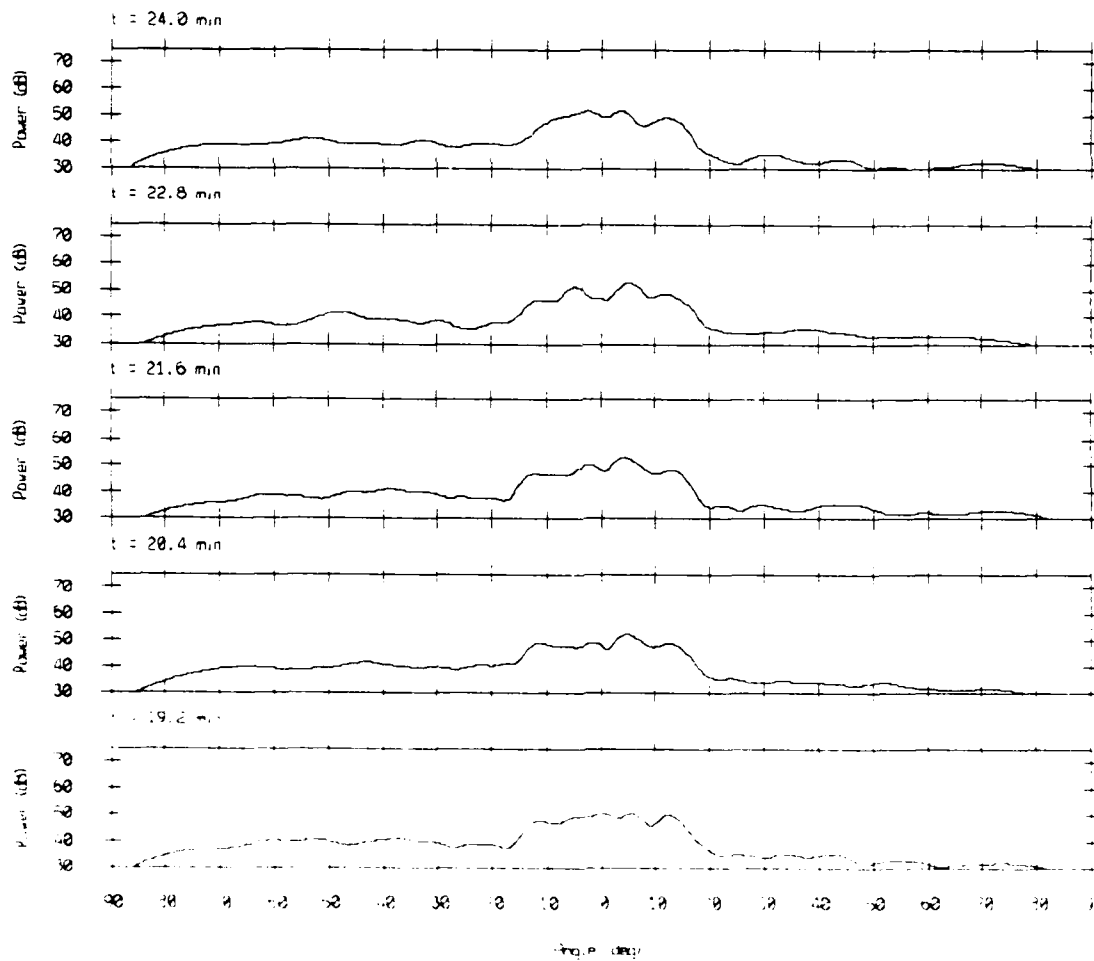
Array Response - 85010 Bin #6343

$f = 248.88$  Hz, K8 window ( $\alpha = 1.5$ )



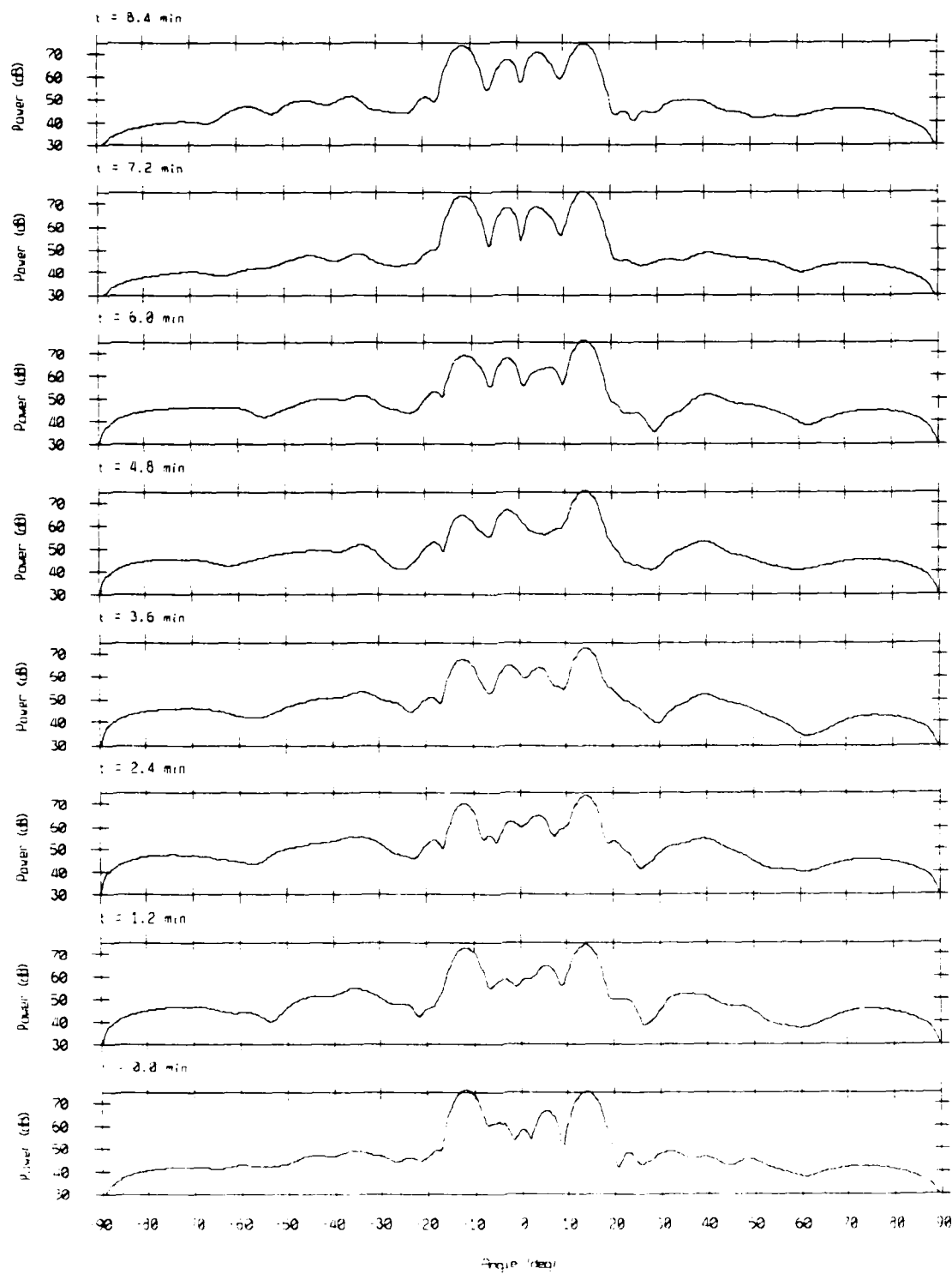
Array Response - 85010 Bin #6343

$f = 248.88$  Hz, KB window ( $\alpha = 1.5$ )



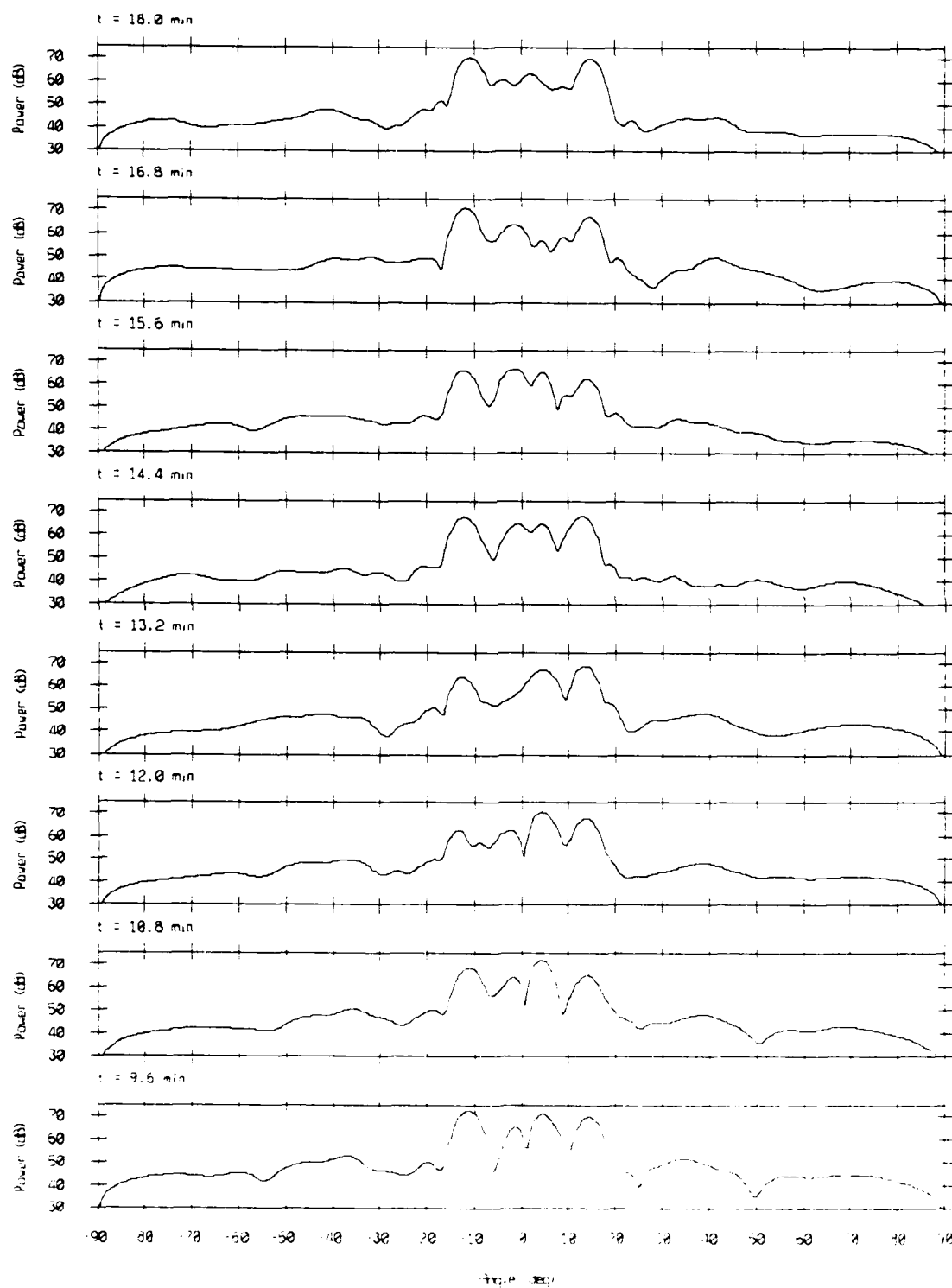
Array Response - 85010 Bin #6348

$f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



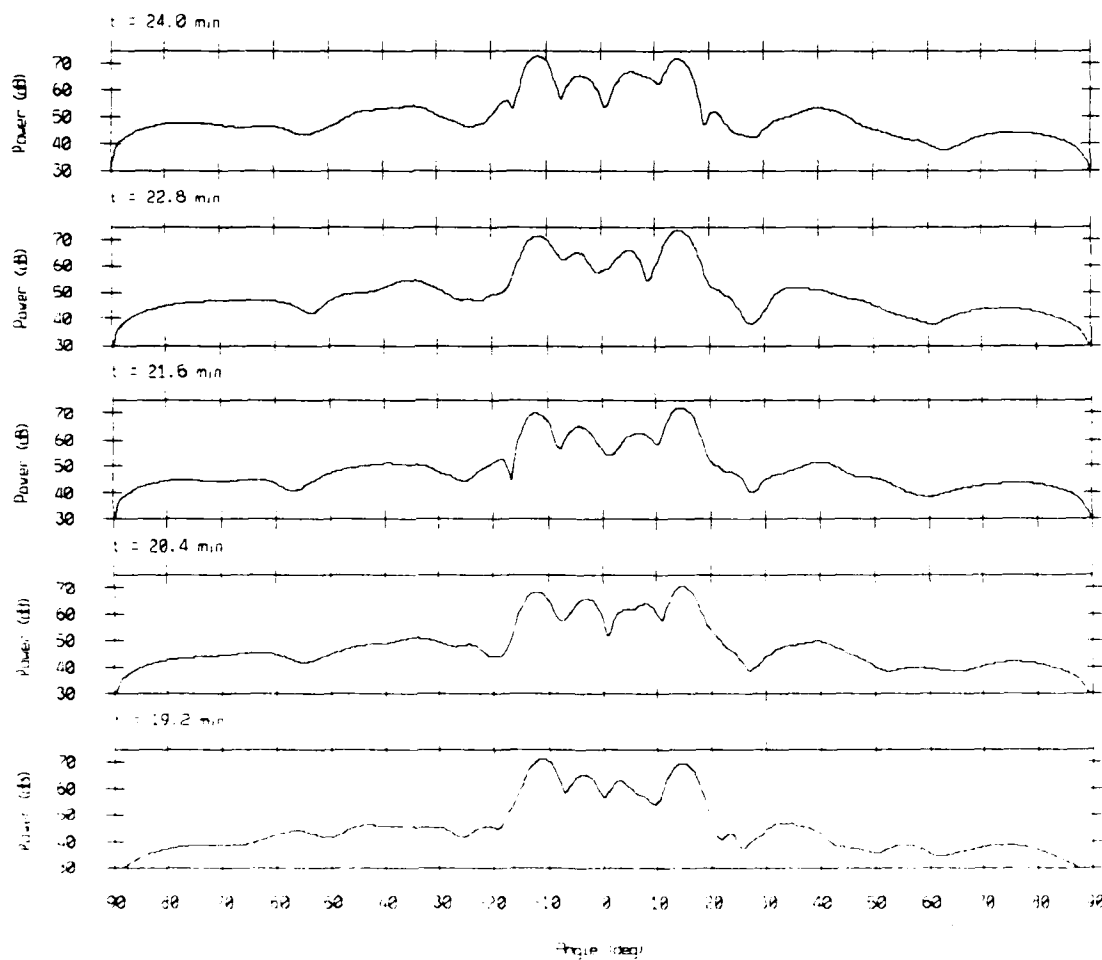
Array Response - 85010 Bin #6348

$f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



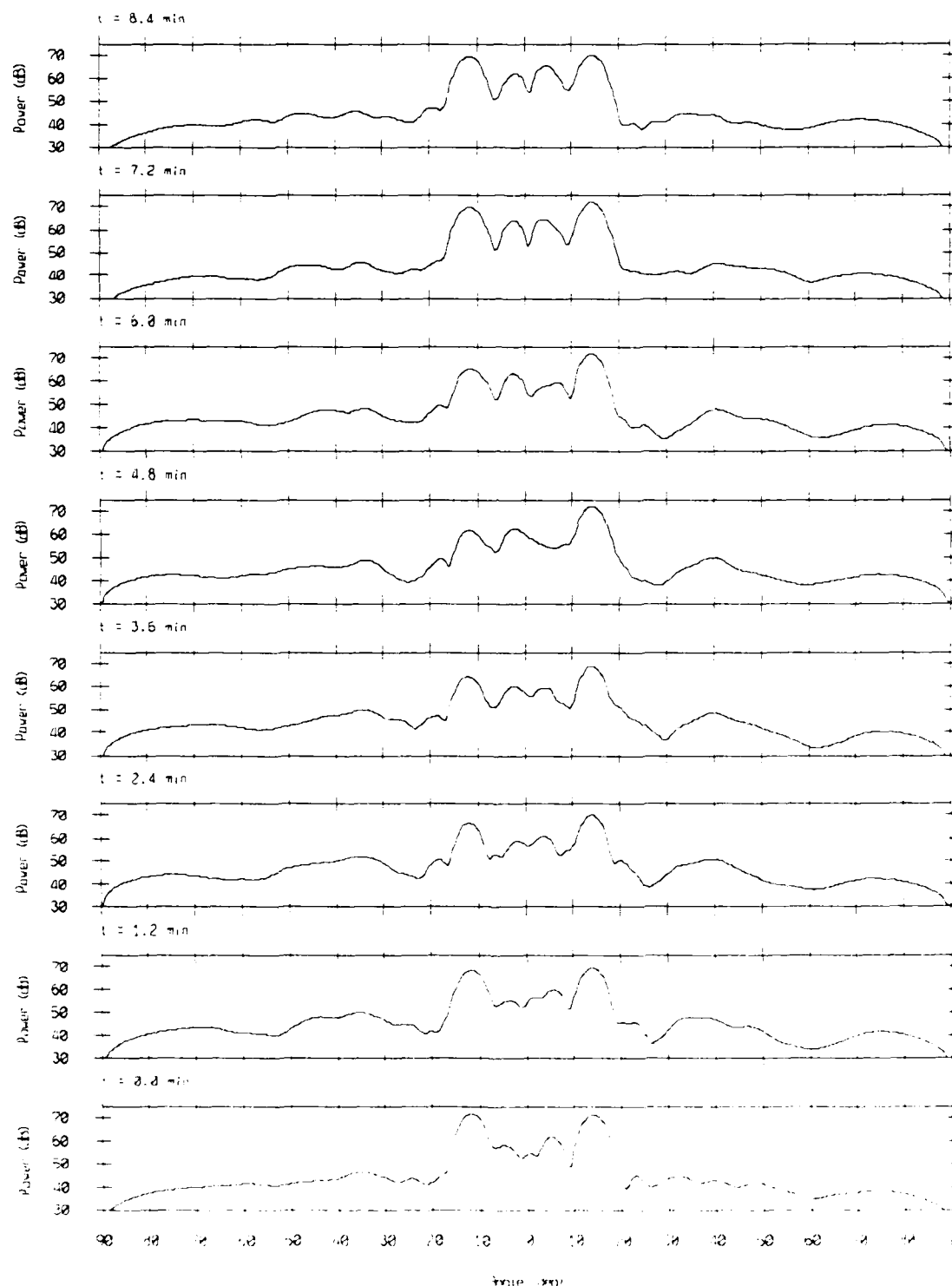
Array Response - 85010 Bin #6348

$f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



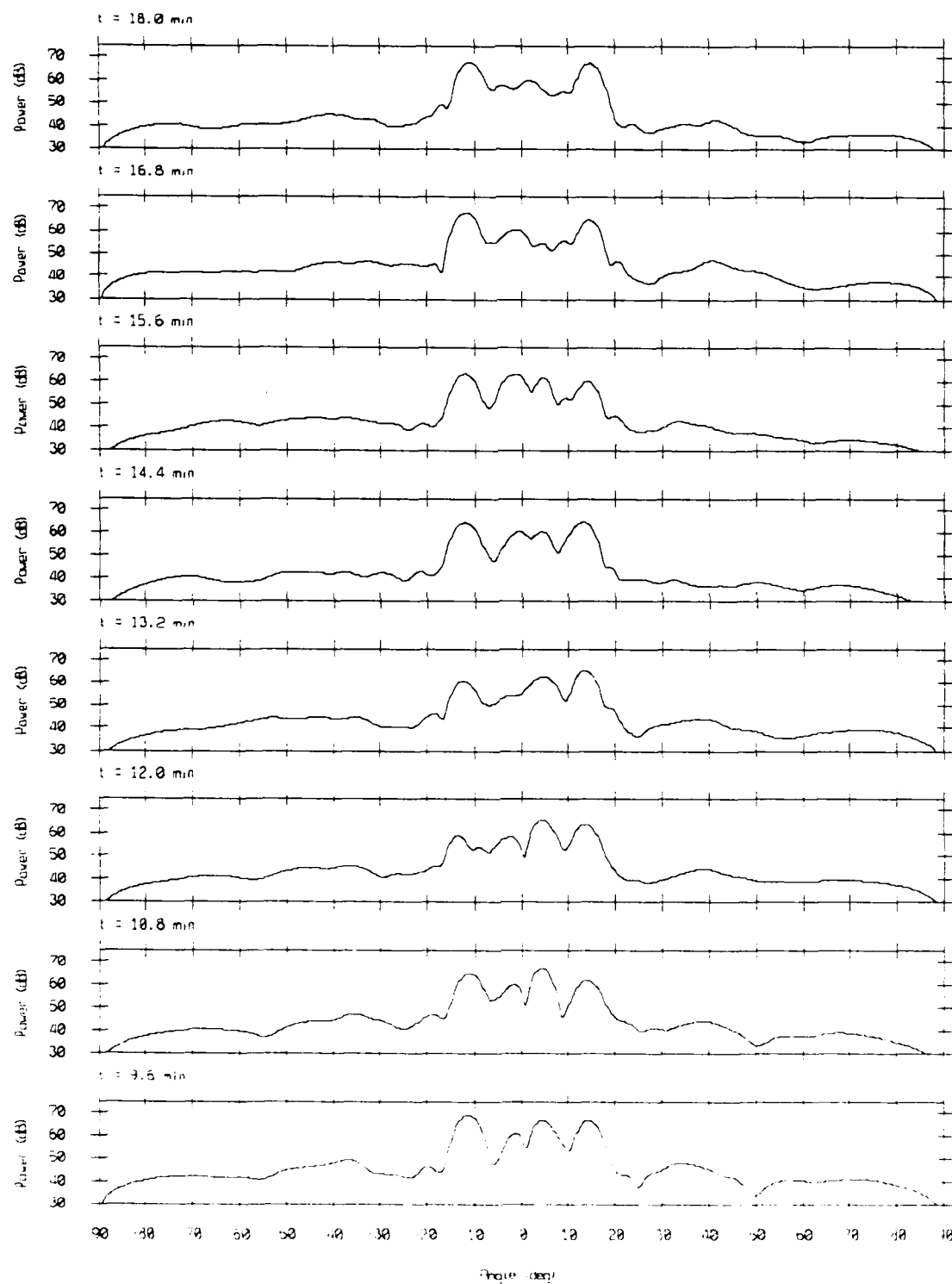
Array Response - 85010 Bin #6349

$f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



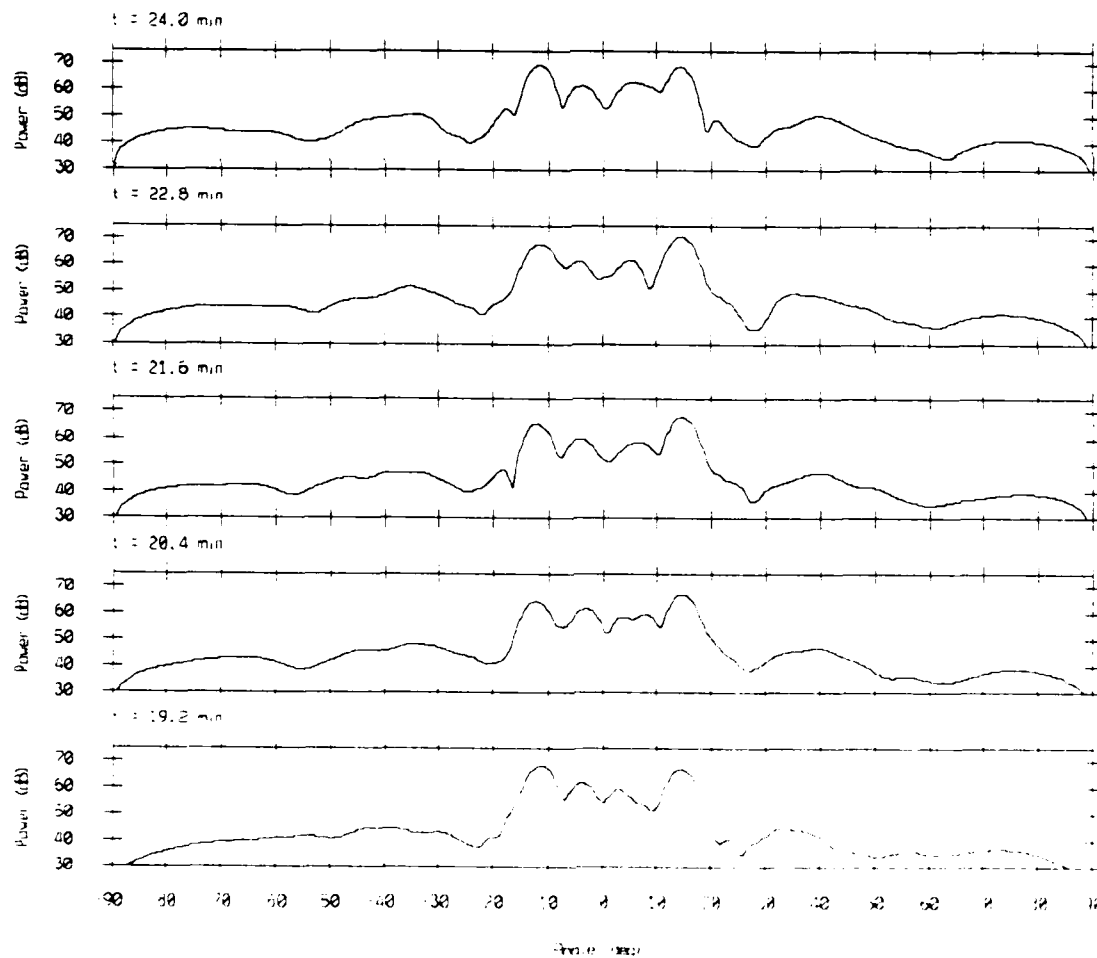
Array Response - 85010 Bin #6349

$f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



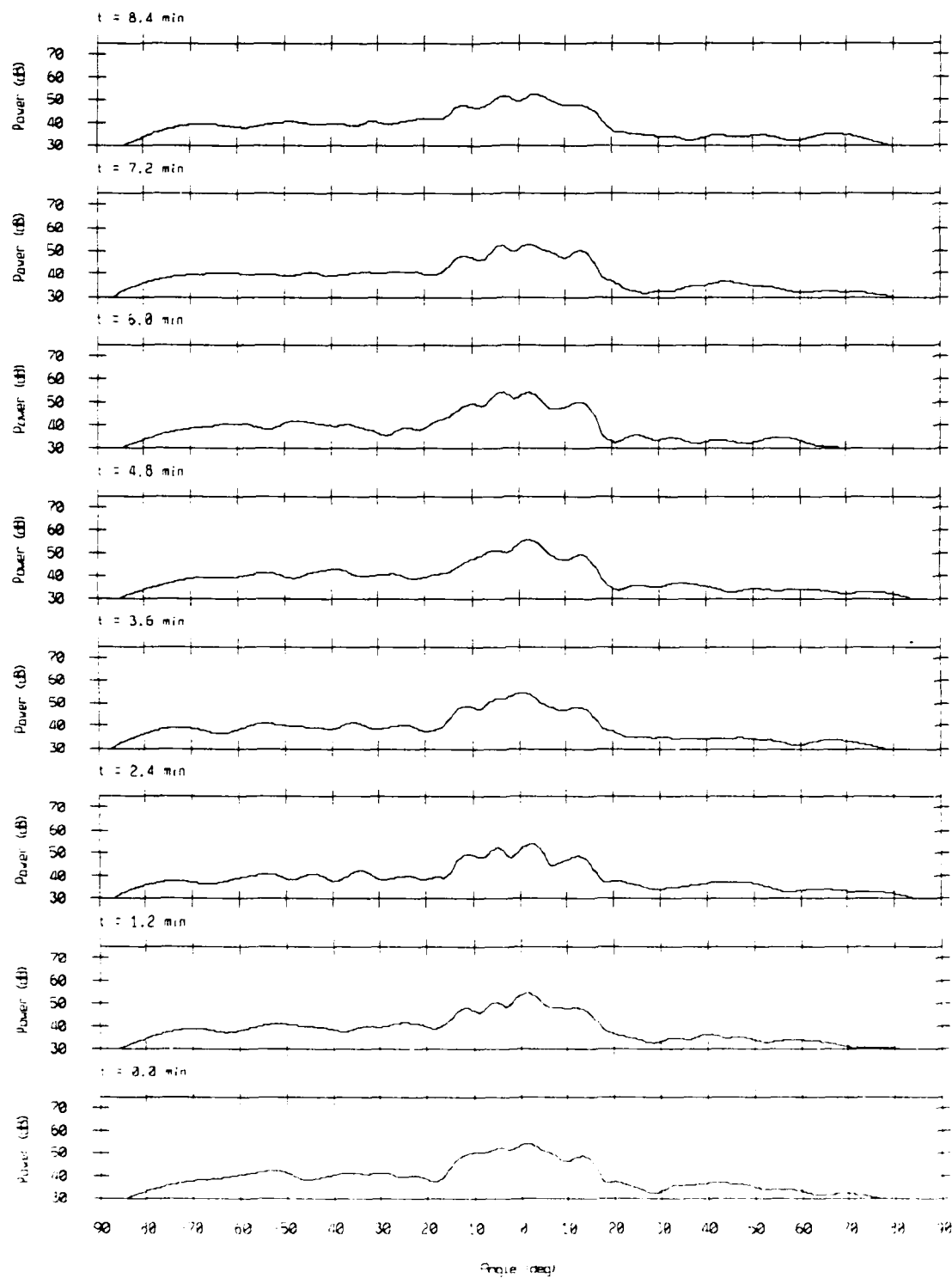
Array Response - 85010 Bin #6349

$f = 249.44$  Hz, KB window ( $\alpha = 1.5$ )



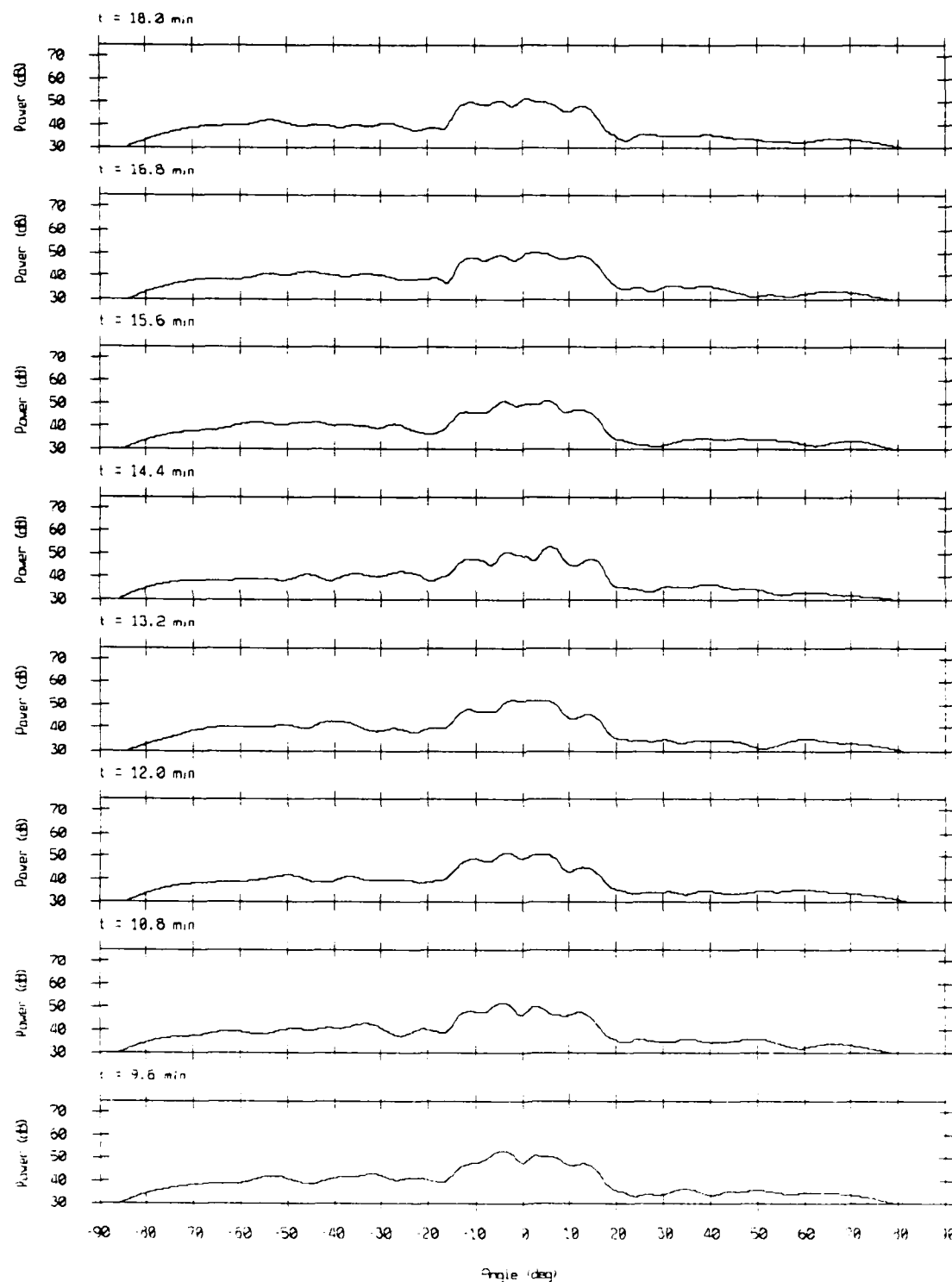
Array Response - 85010 Bin #6354

$f = 250.10$  Hz, KB window ( $\alpha = 1.5$ )



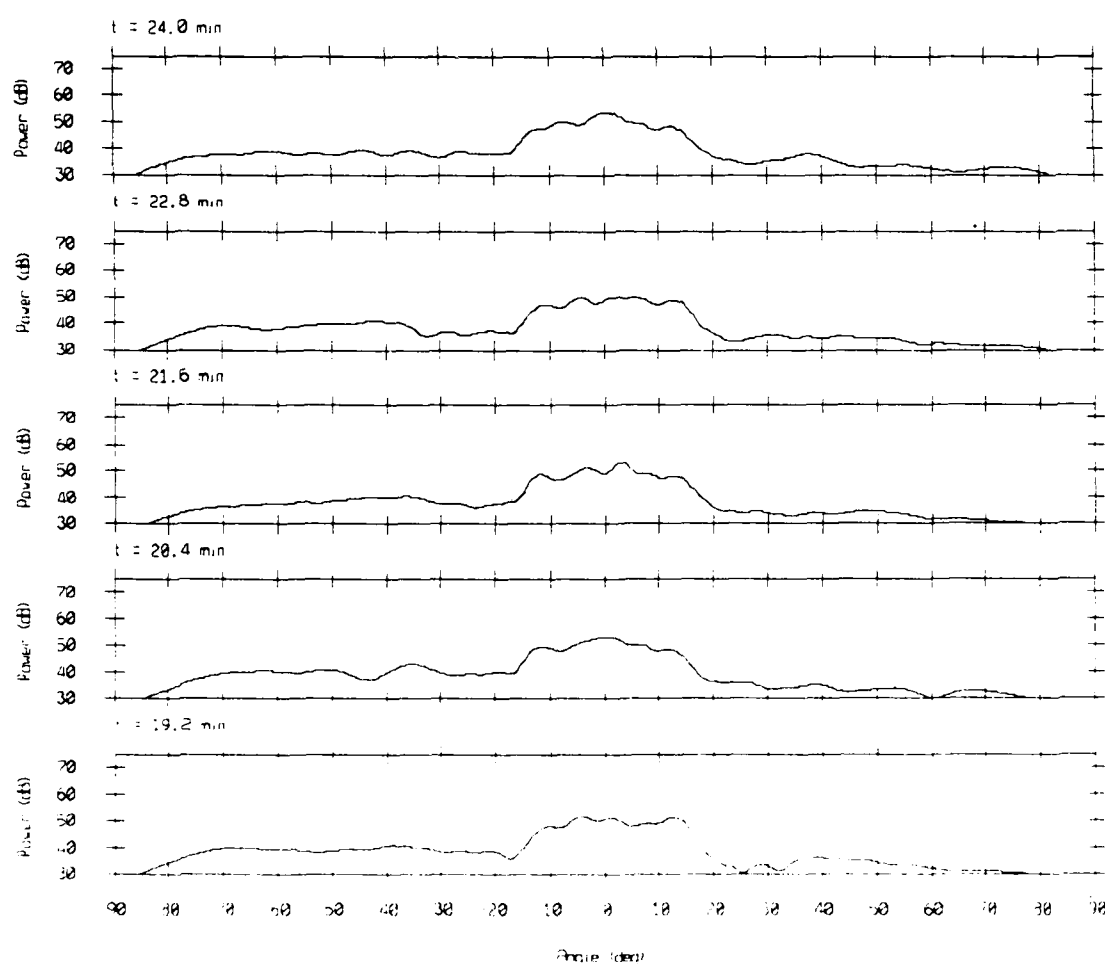
Array Response - 85010 Bin #6354

$f = 250.10$  Hz, KB window ( $\alpha = 1.5$ )



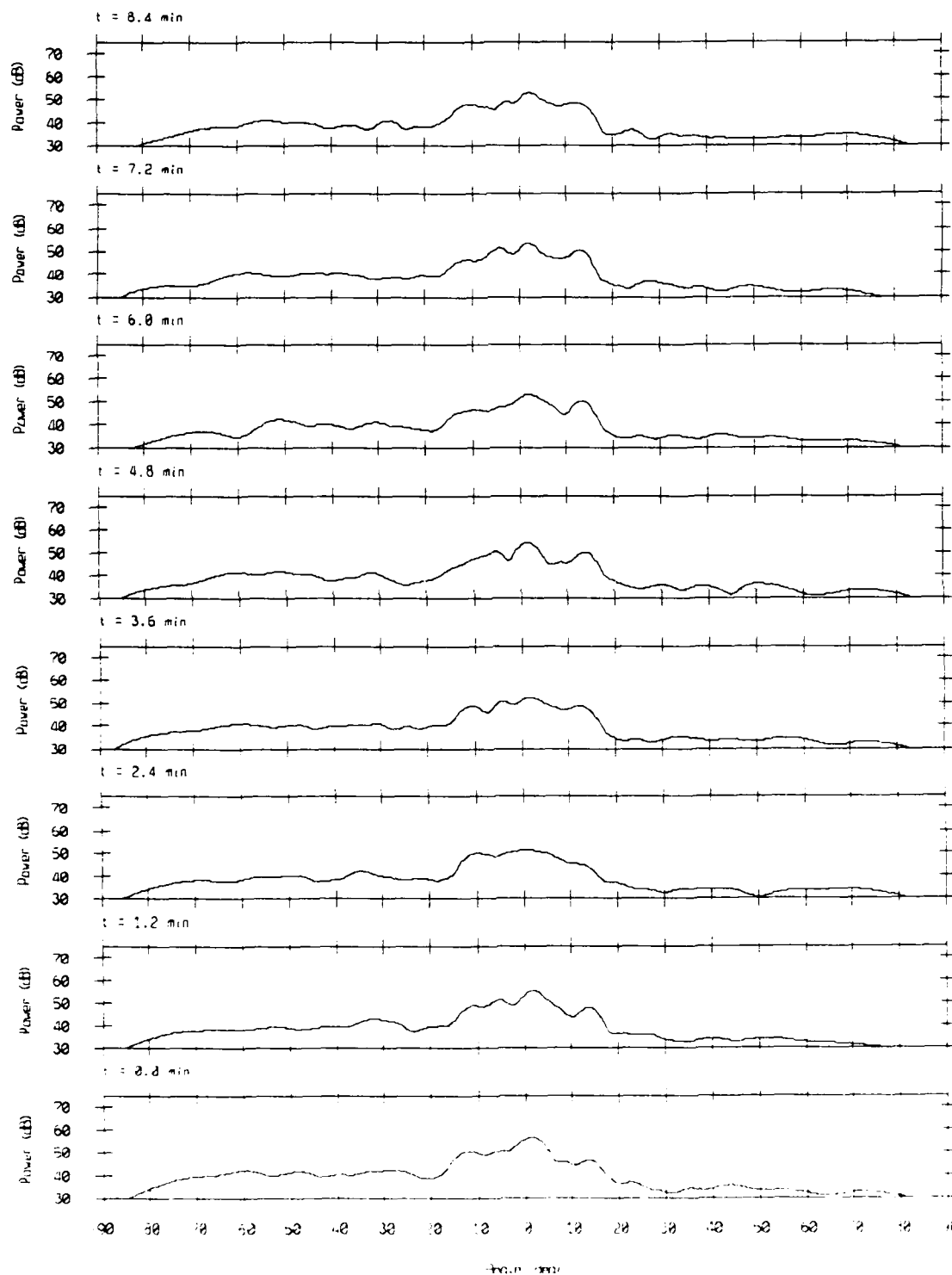
Array Response - 85010 Bin #6354

$f = 250.10$  Hz, KB window ( $\alpha = 1.5$ )



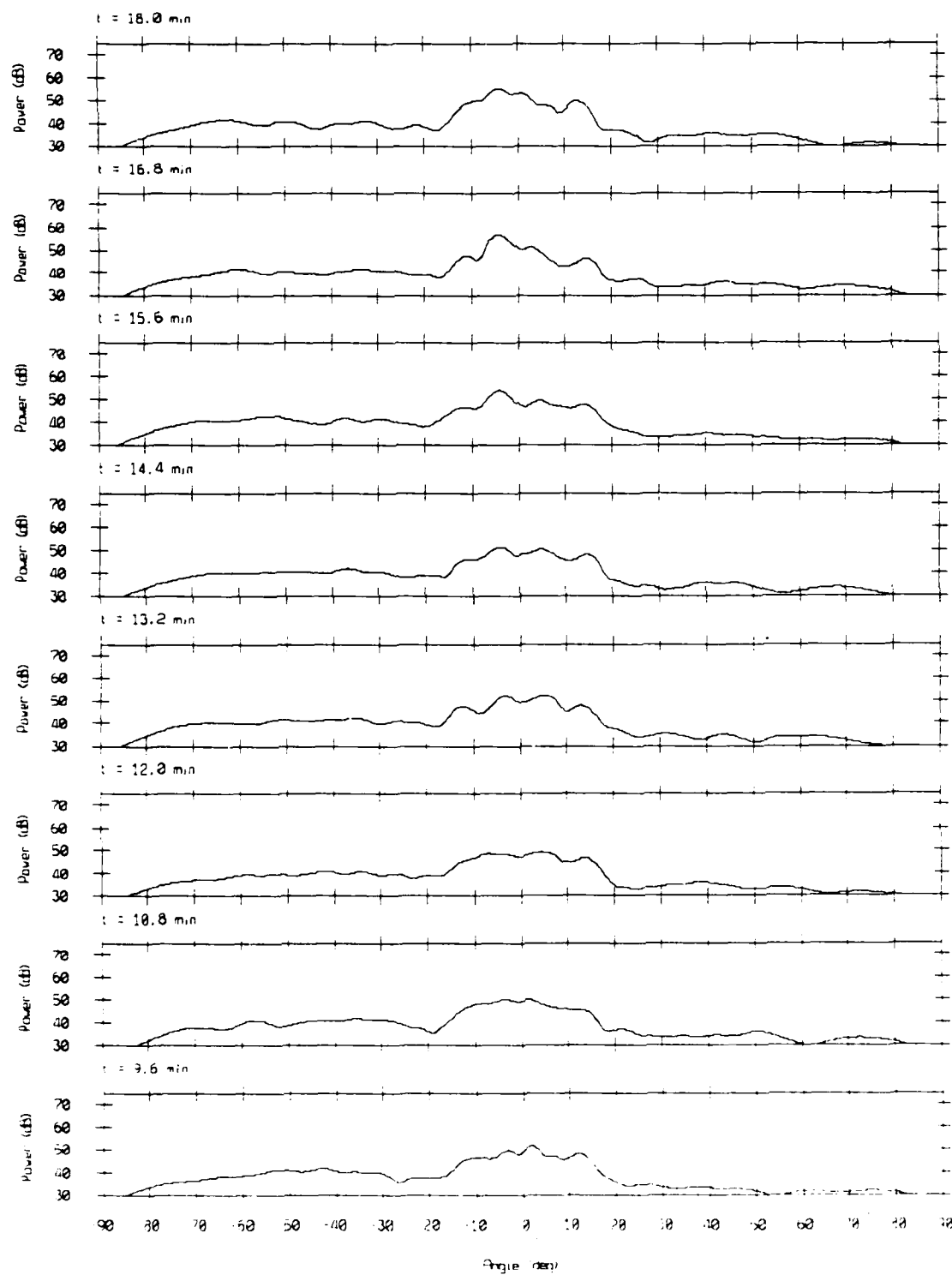
Array Response - 85010 Bin #6388

$f = 253.87$  Hz, KB window ( $\alpha = 1.5$ )



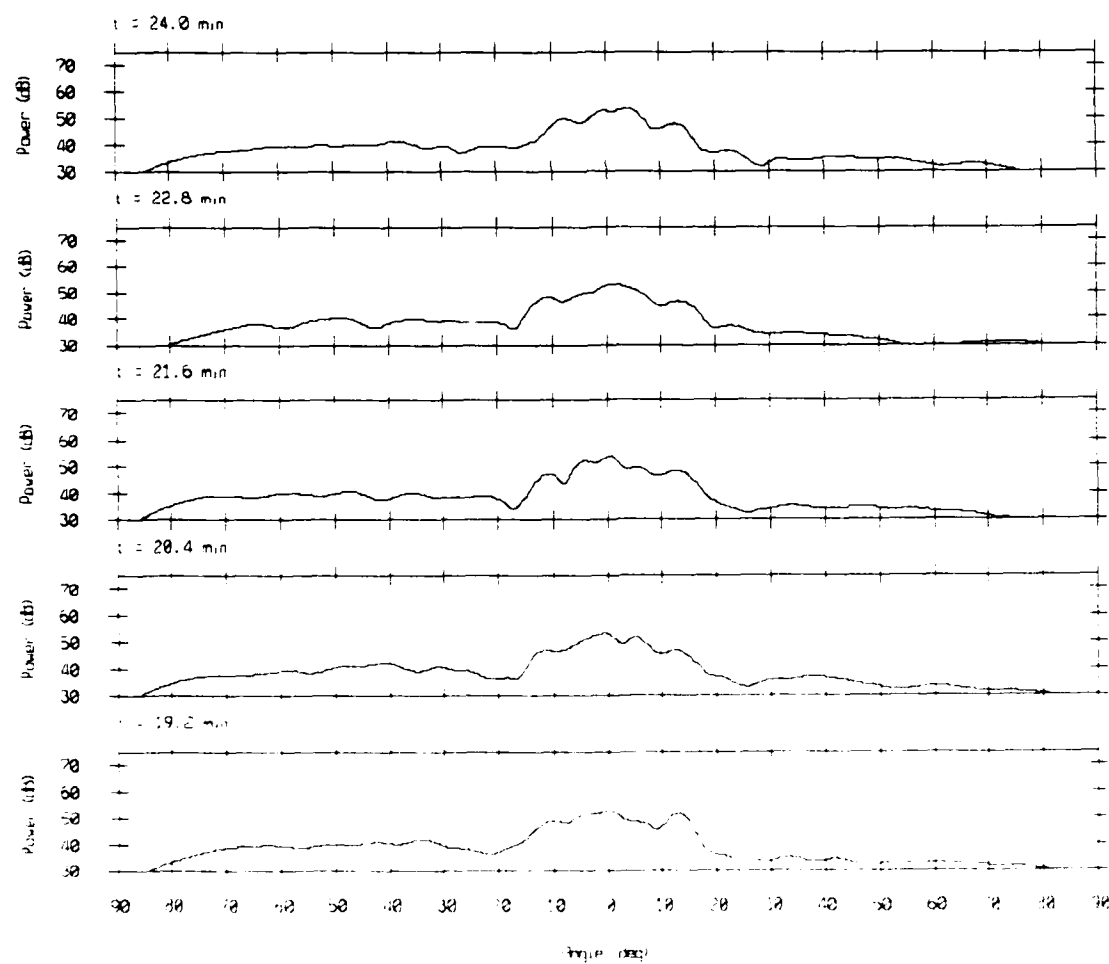
Array Response - 85010 Bin #6388

$f = 253.87$  Hz, KB window ( $\alpha = 1.5$ )



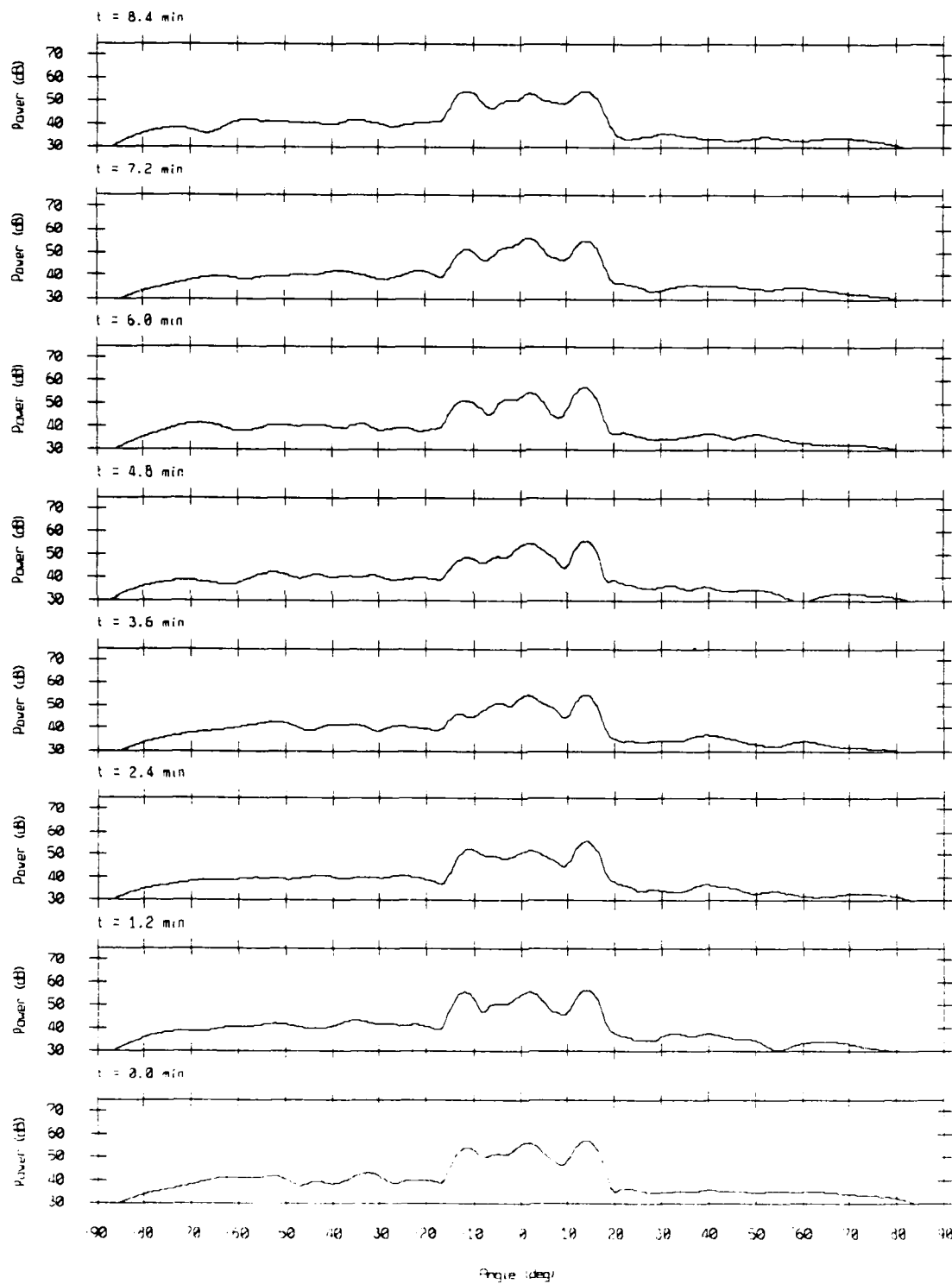
Array Response - 85010 Bin #6388

$f = 253.87$  Hz, KB window ( $\alpha = 1.5$ )



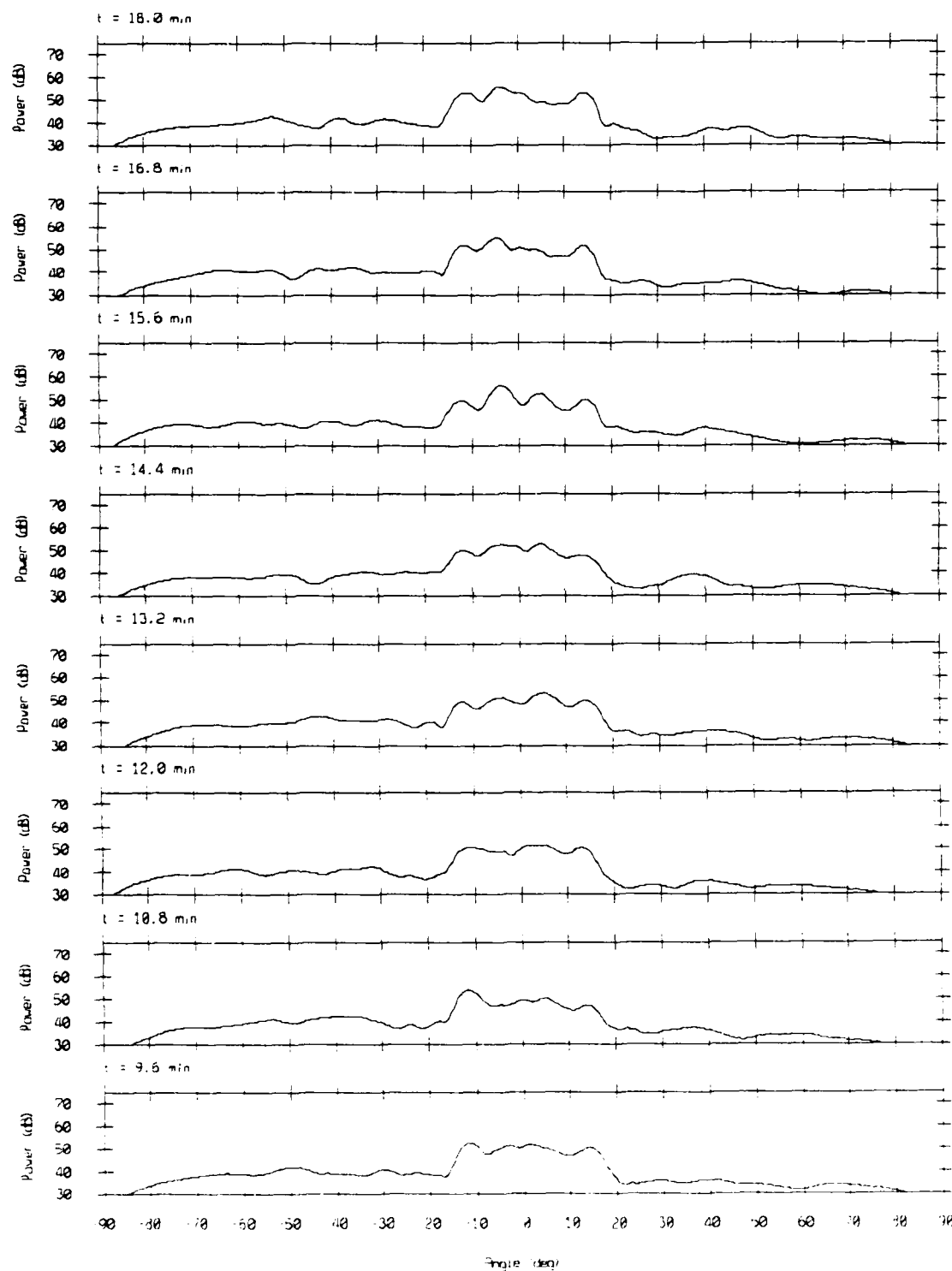
Array Response - 85010 Bin #6393

$f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



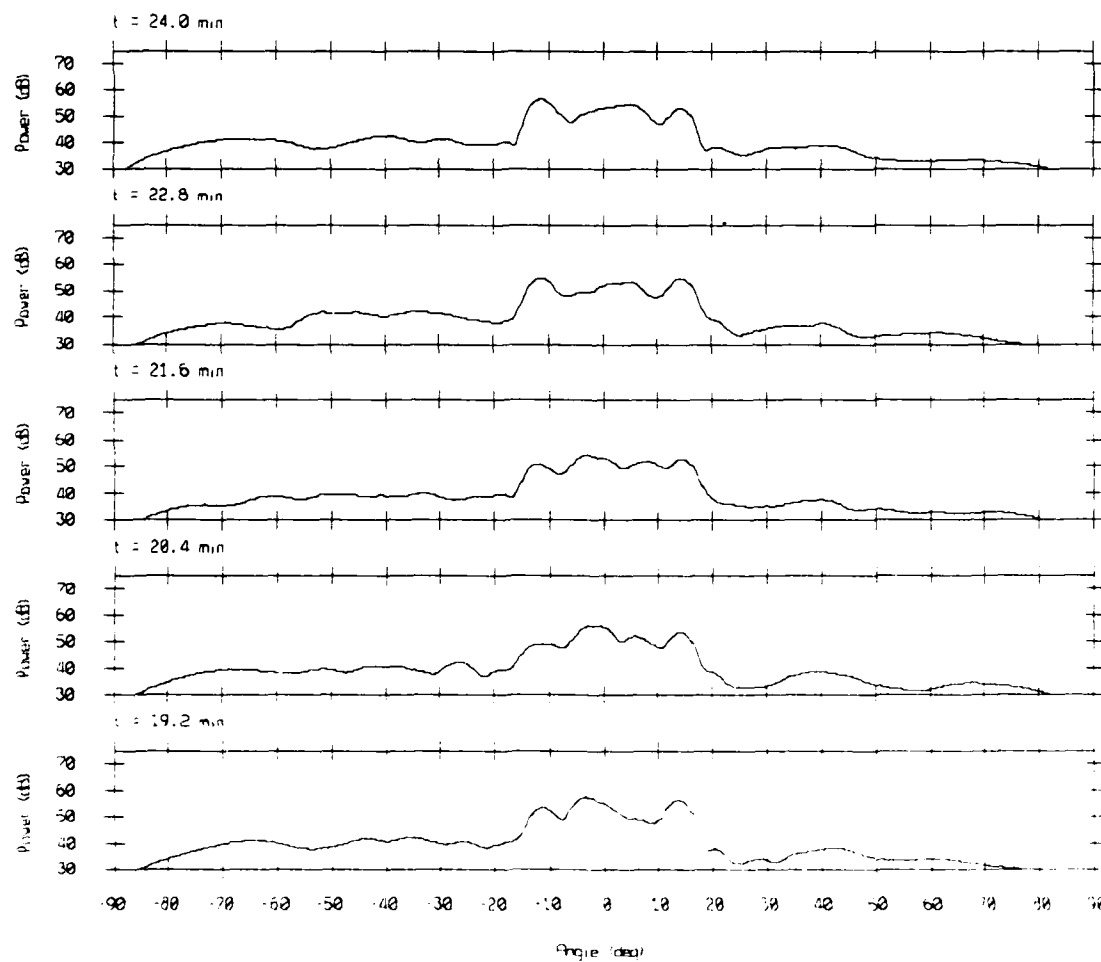
Array Response - 85010 Bin #6393

$f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



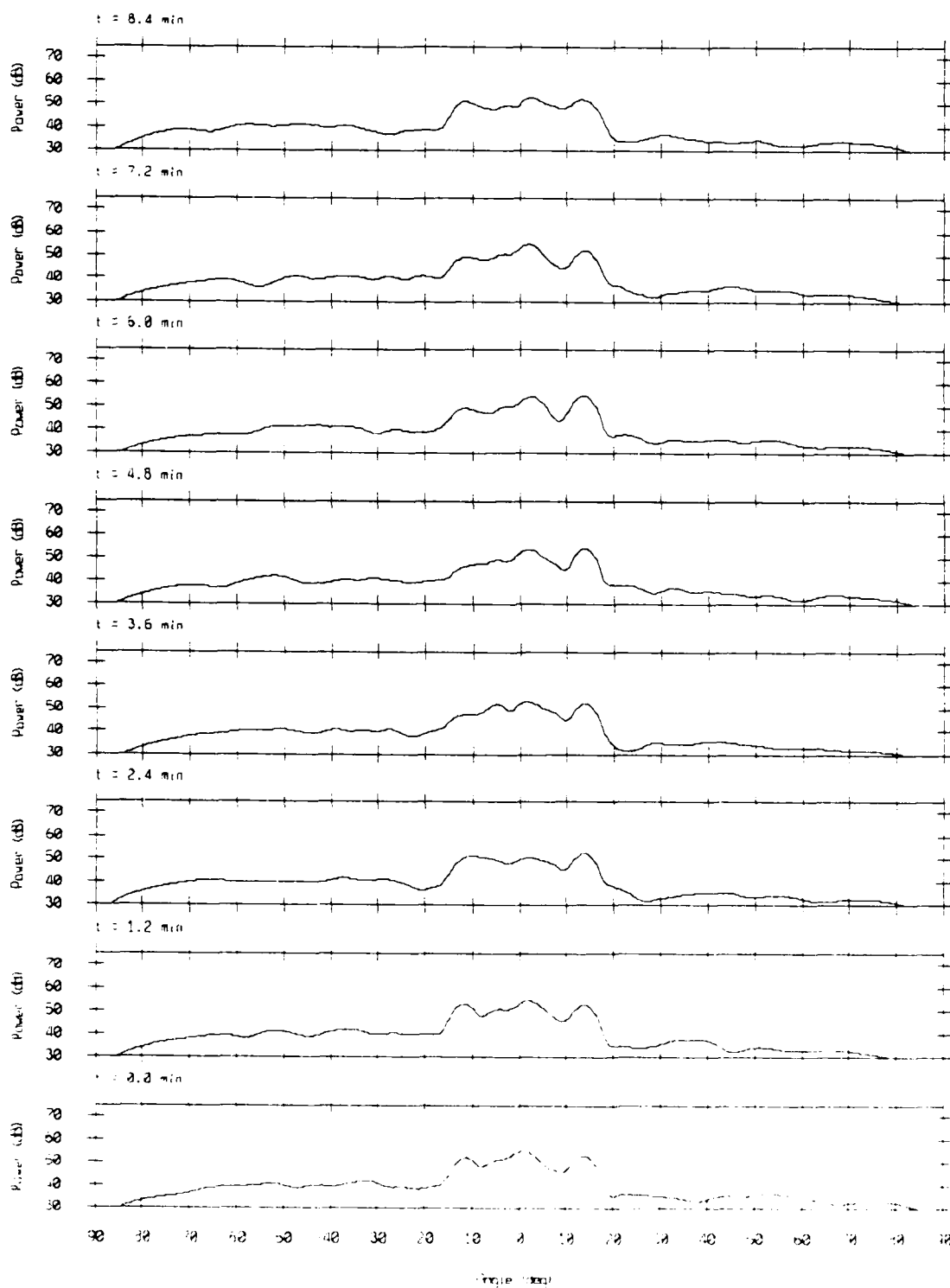
Array Response - 85010 Bin #6393

$f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



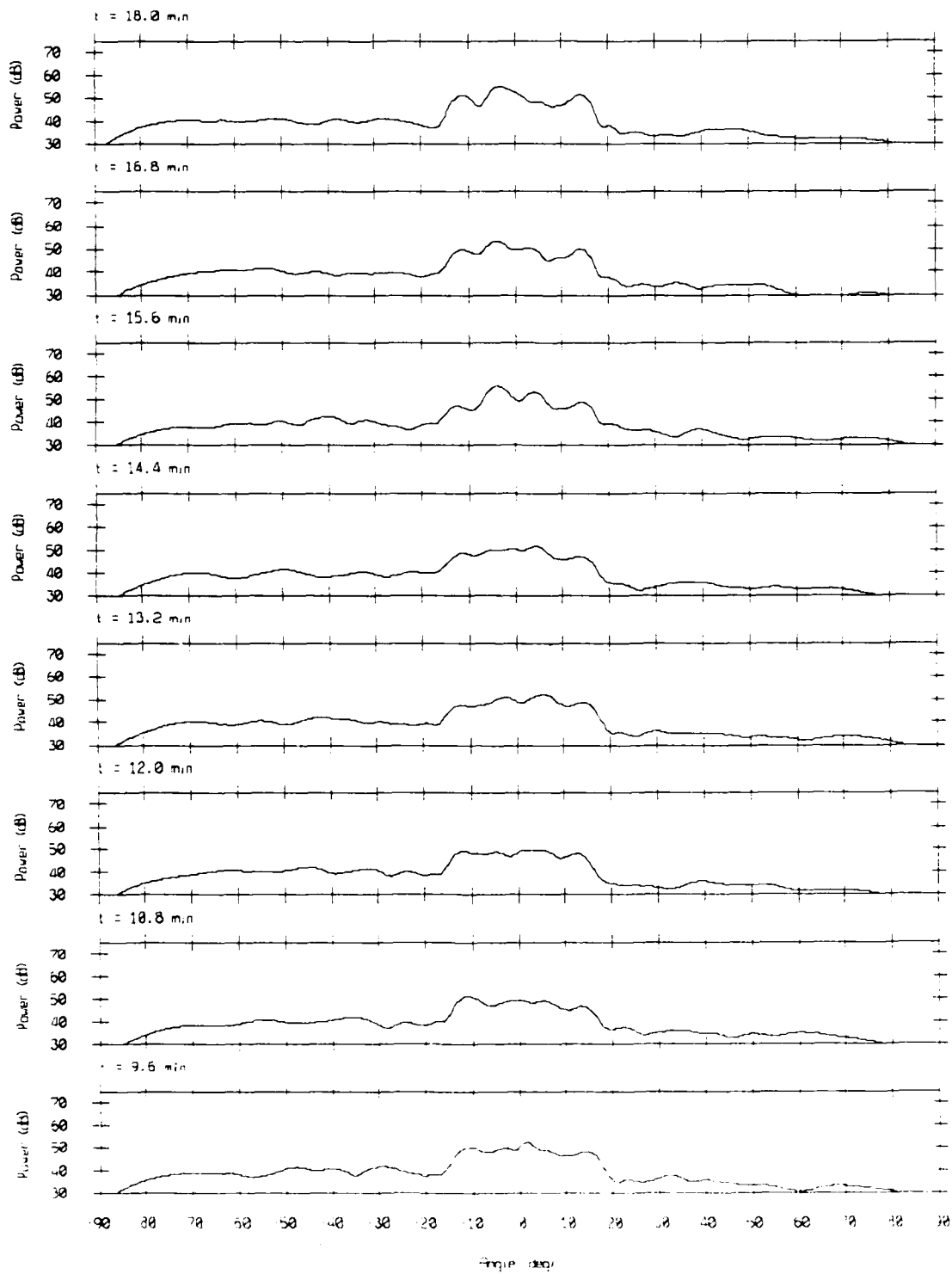
# Array Response - 85010 Bin #6394

$f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



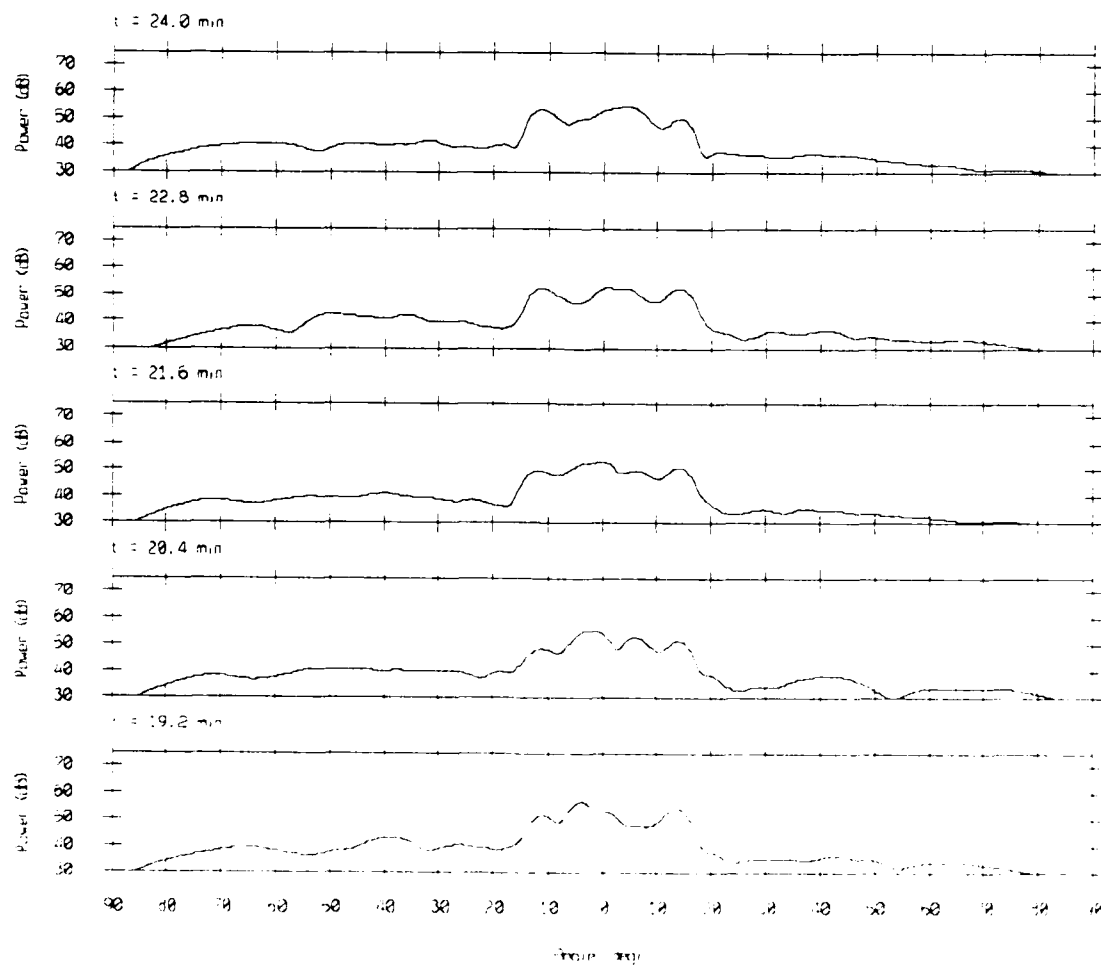
Array Response - 85010 Bin #6394

$f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



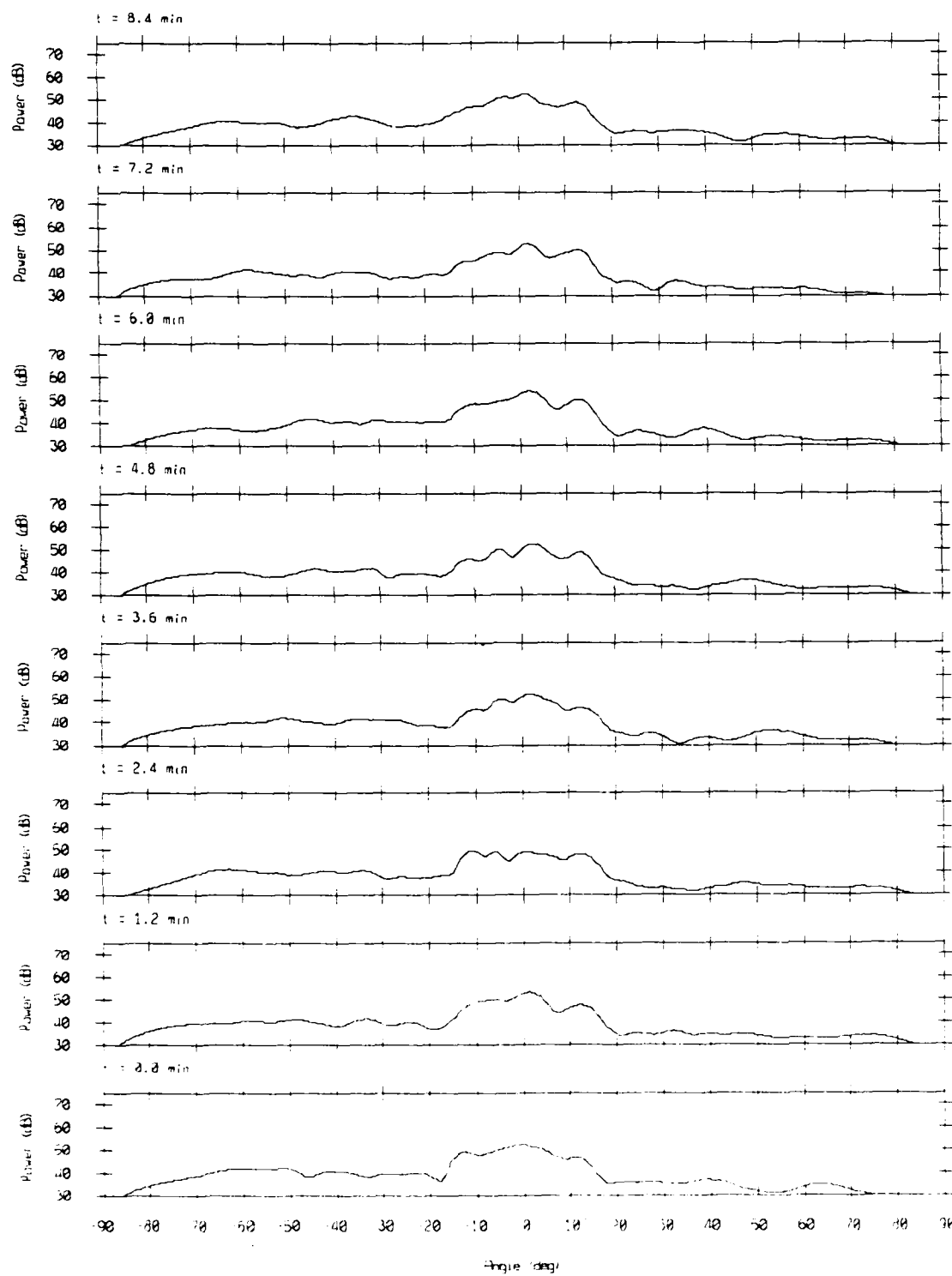
Array Response - 85010 Bin #6394

$f = 254.42$  Hz, KB window ( $\alpha = 1.5$ )



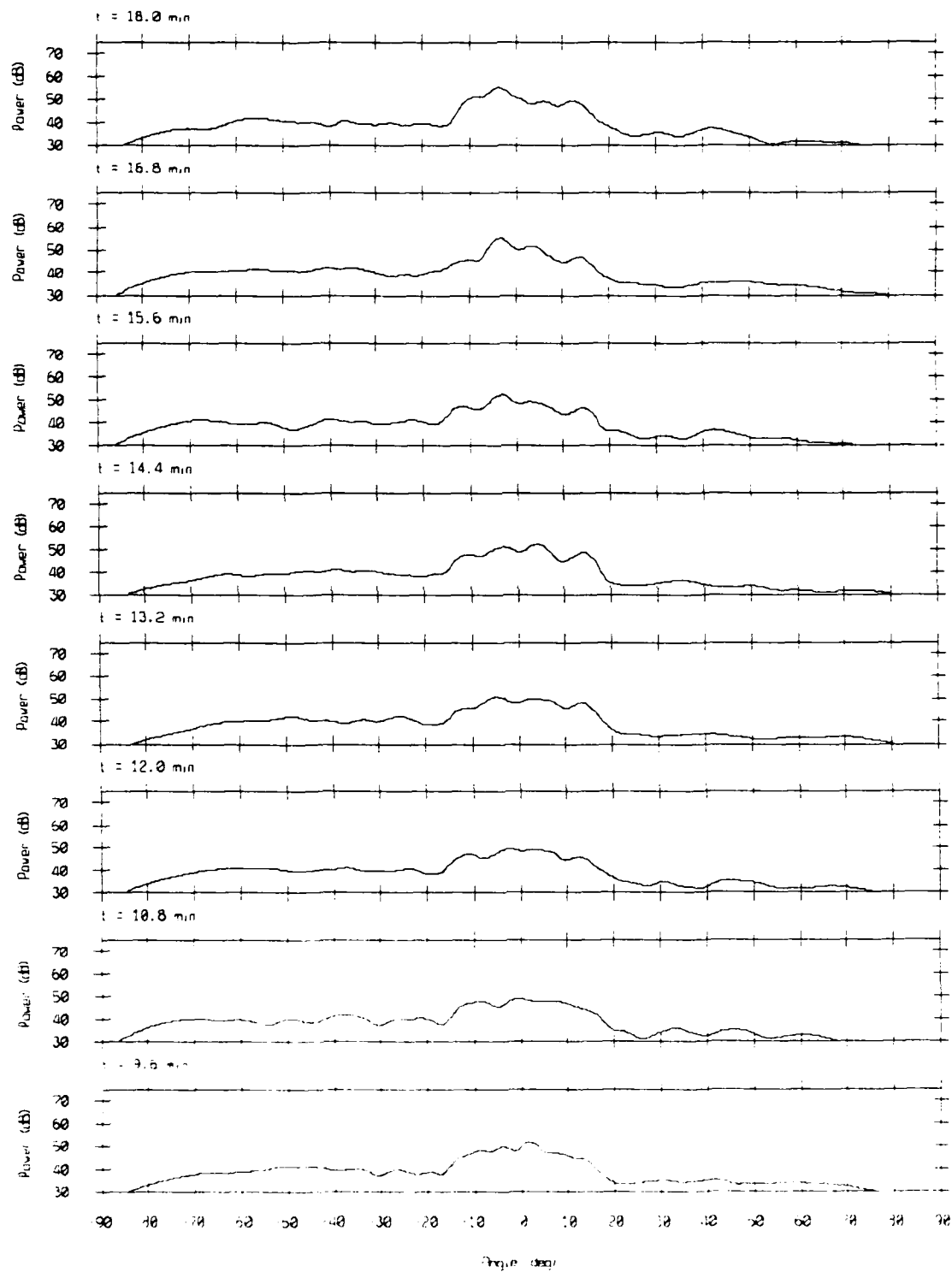
Array Response - 85010 Bin #6399

$f = 255.09$  Hz, KB window ( $\alpha = 1.5$ )



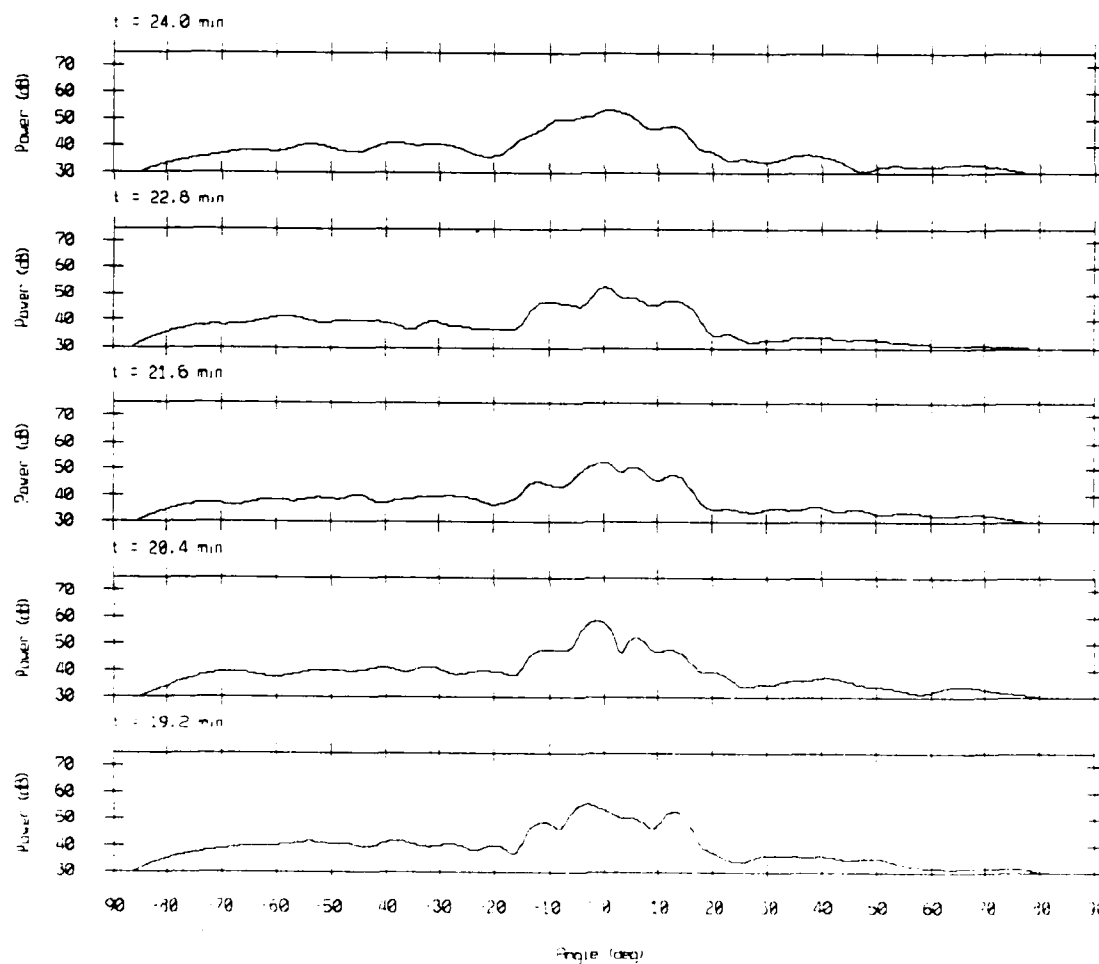
Array Response - 85010 Bin #6399

$f = 255.09$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 85010 Bin #6399

$f = 255.09$  Hz, KB window ( $\alpha = 1.5$ )

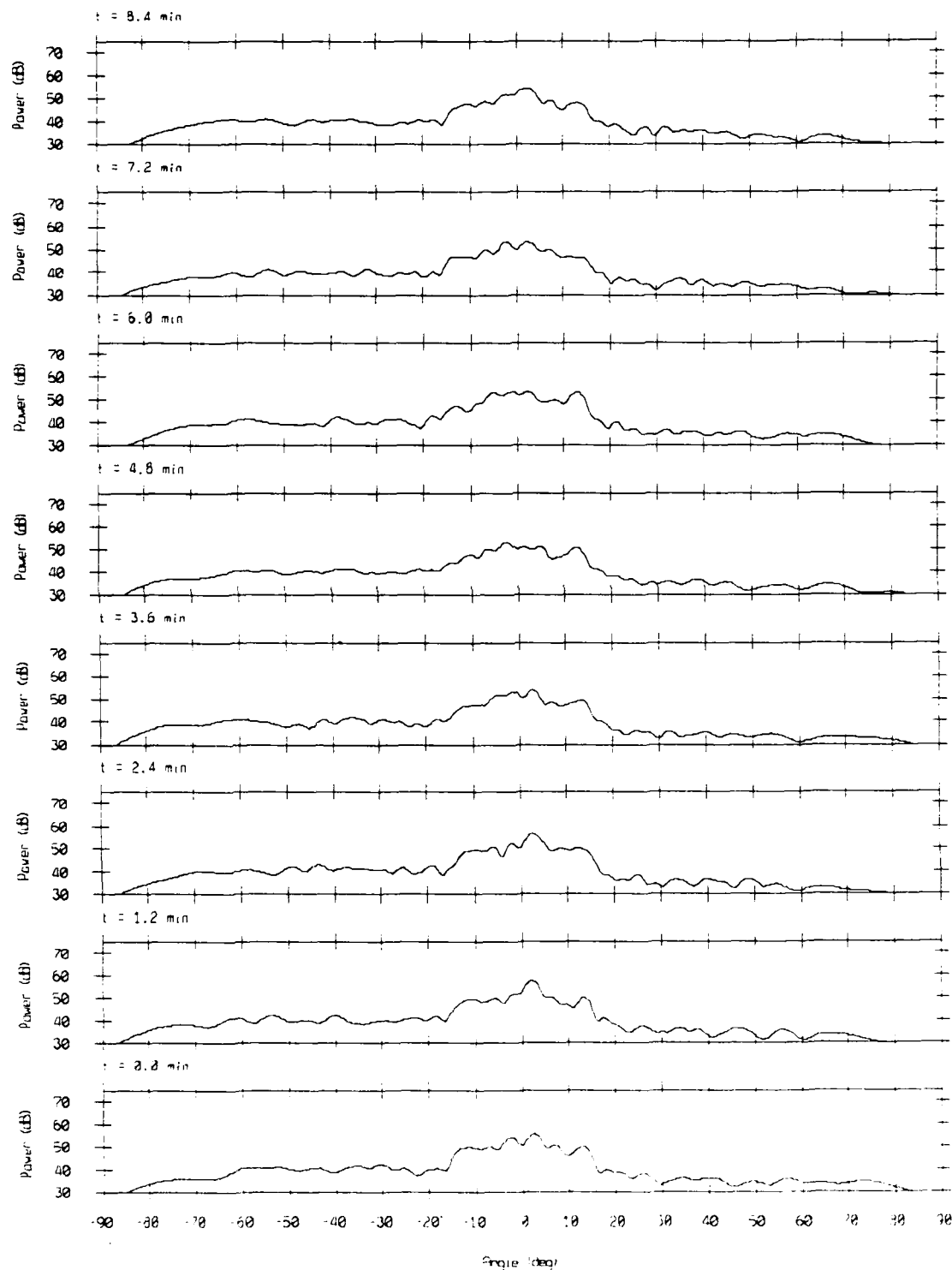


IV. Tape #85010.

F. Array Response: Panels, Rect Window.

Array Response - 85010 Bin #6298

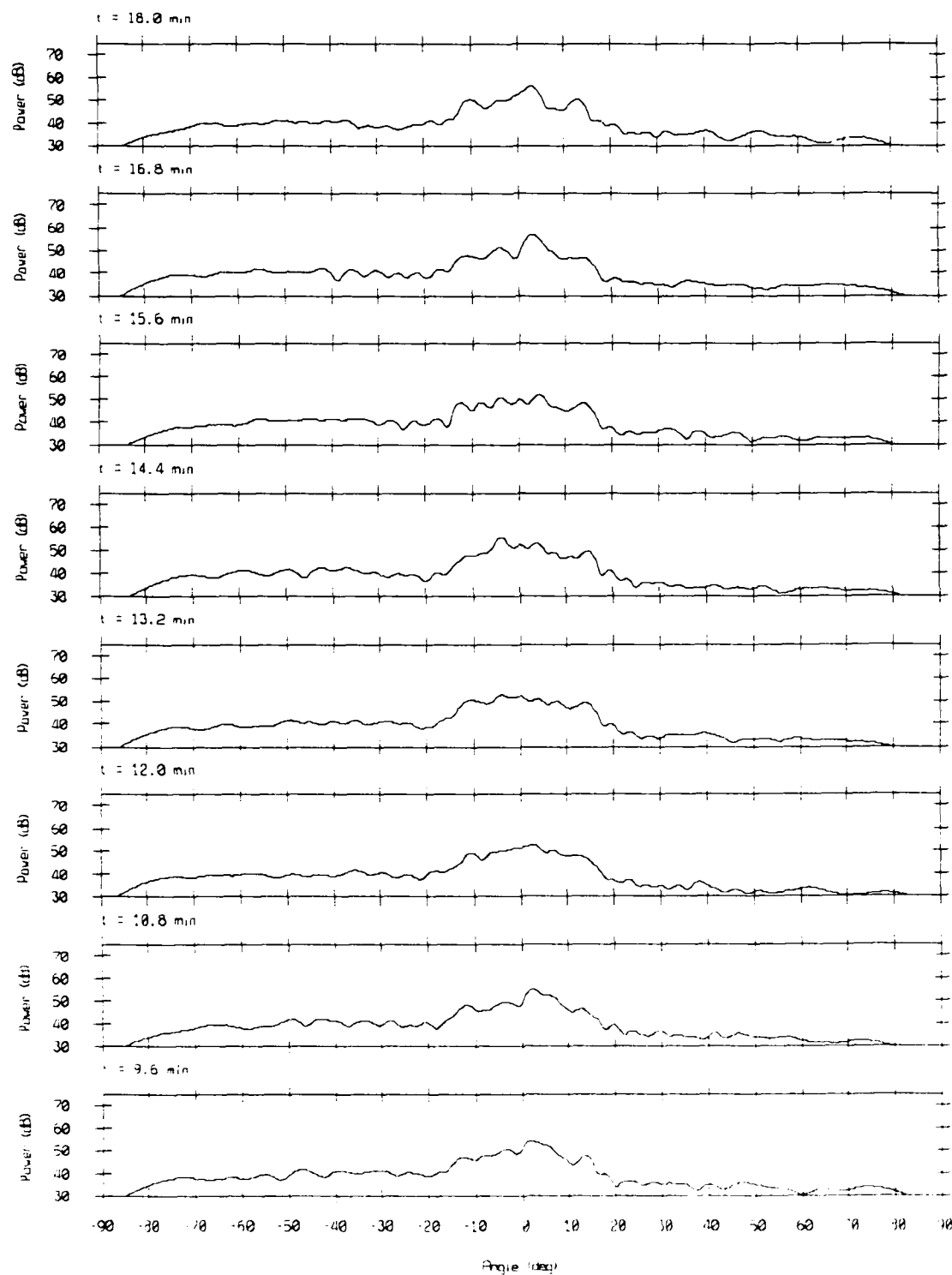
$f = 243.90$  Hz, rect window



Angle (deg)

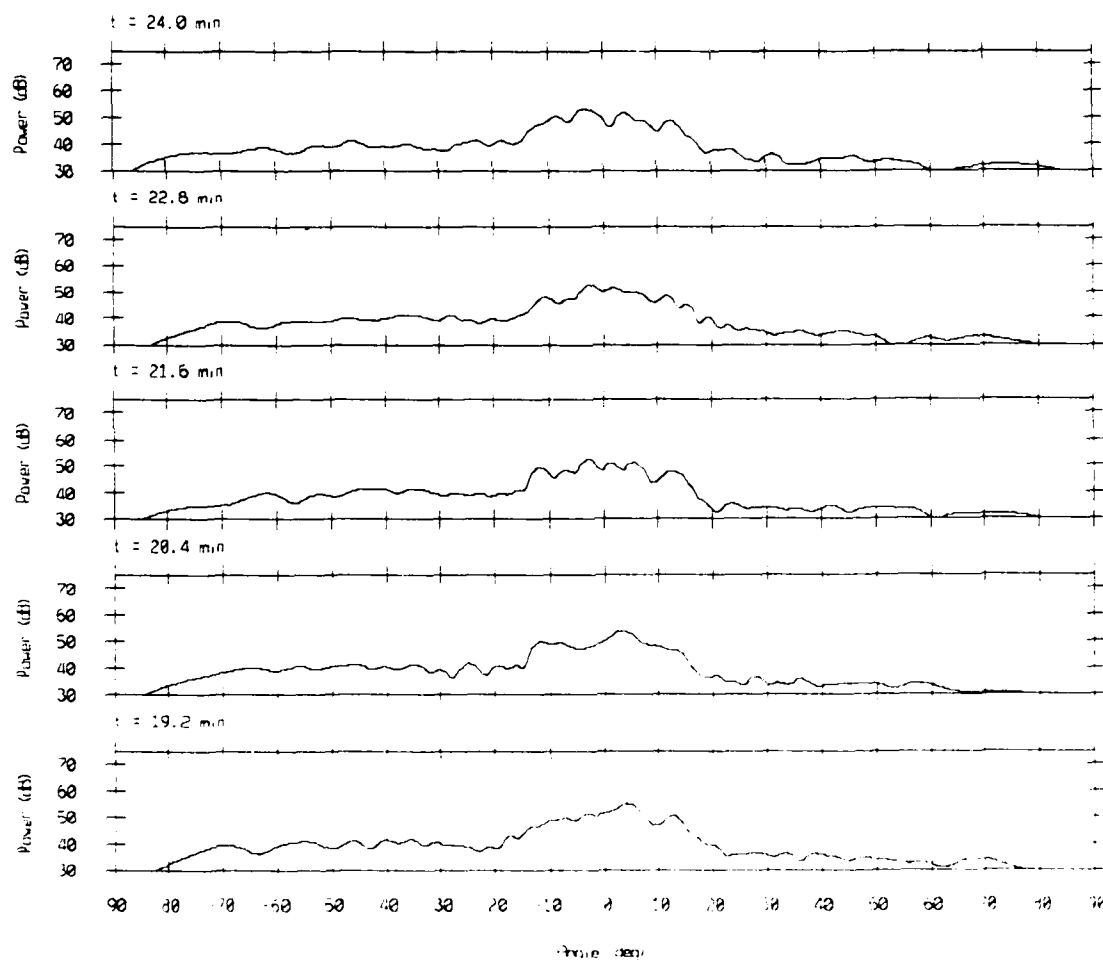
# Array Response - 85010 Bin #6298

$f = 243.90$  Hz, rect window



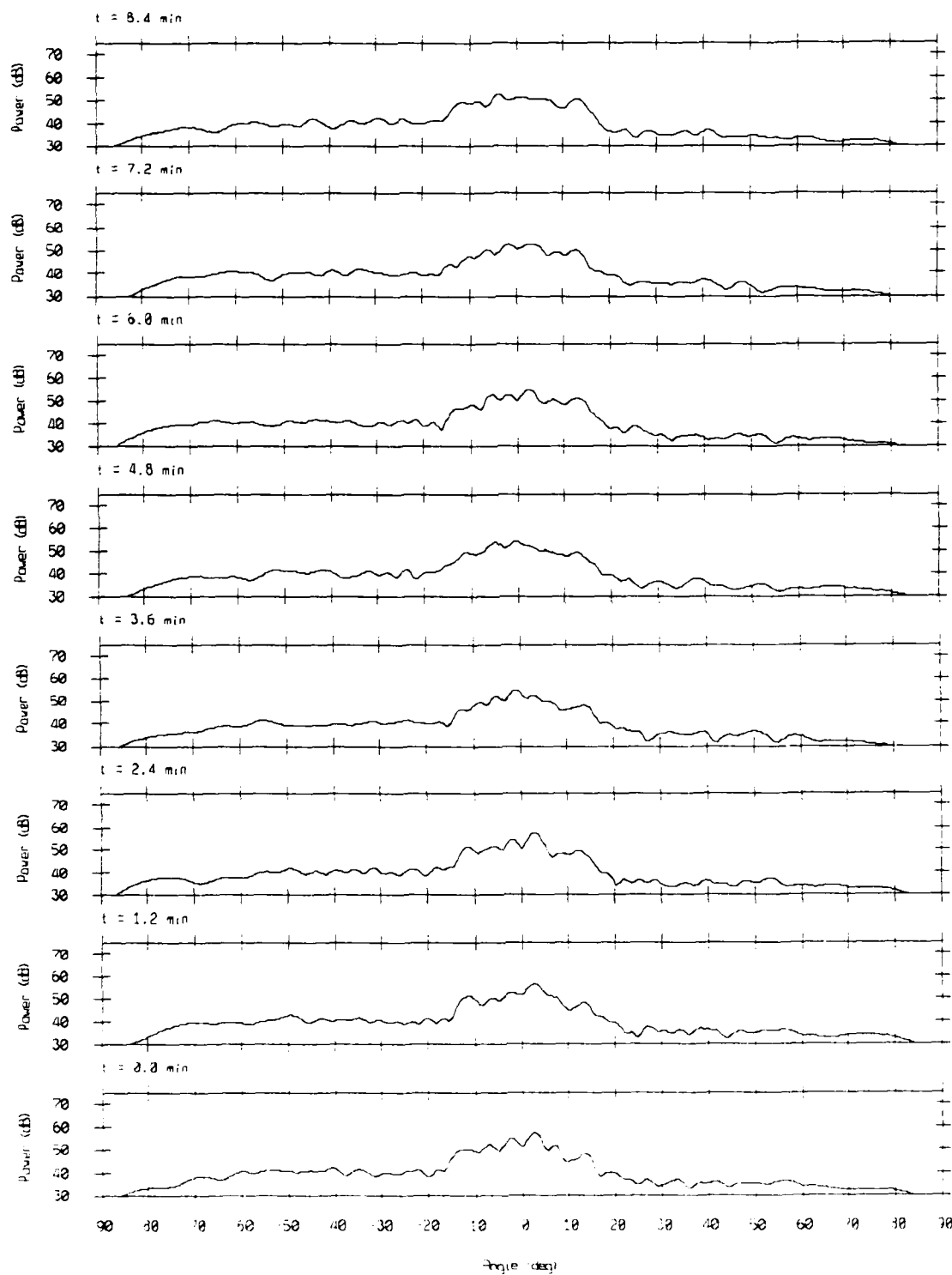
Array Response - 85010 Bin #6298

$f = 243.90$  Hz, rect window



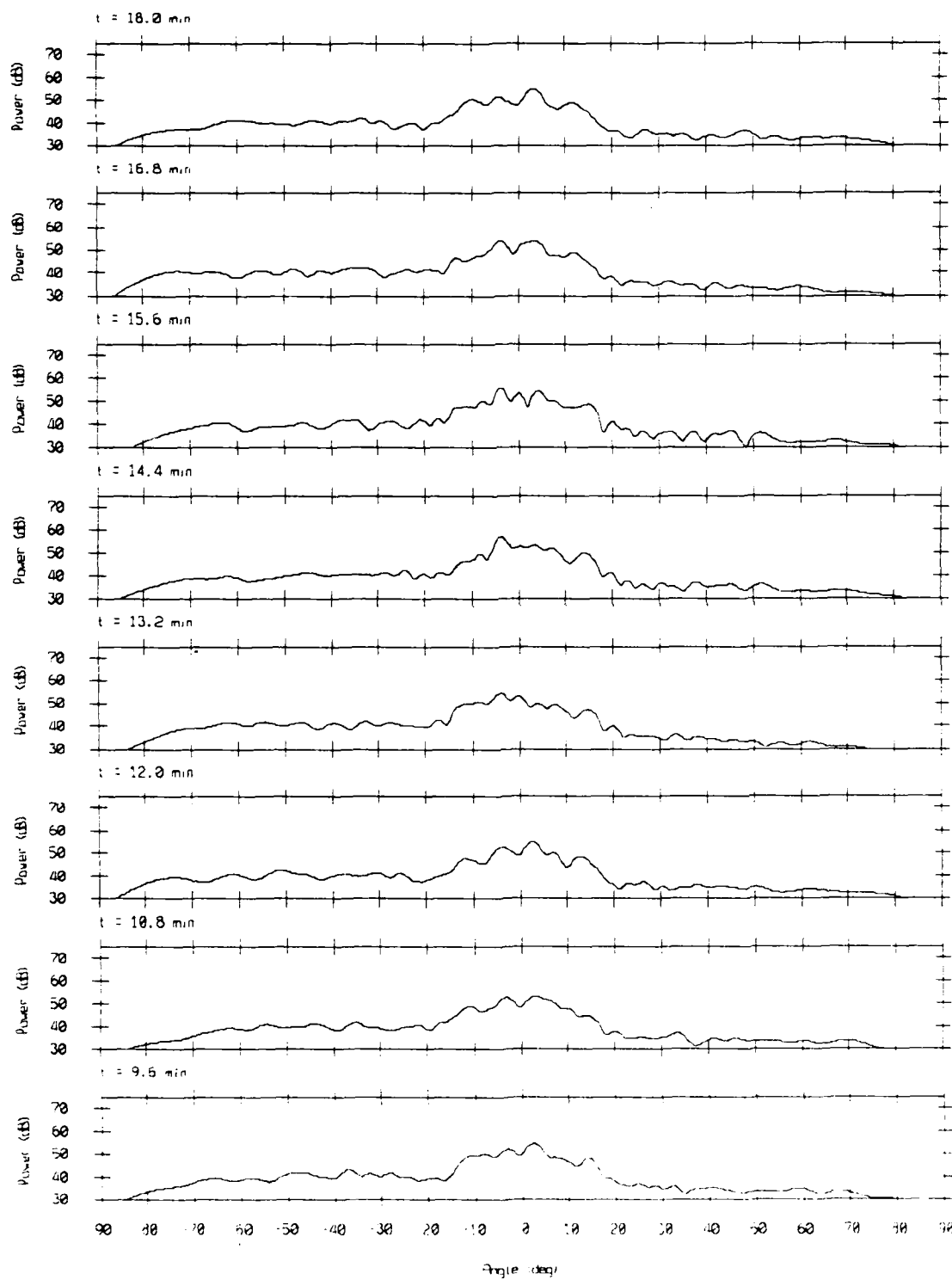
# Array Response - 85010 Bin #6303

f = 244.45 Hz, rect window



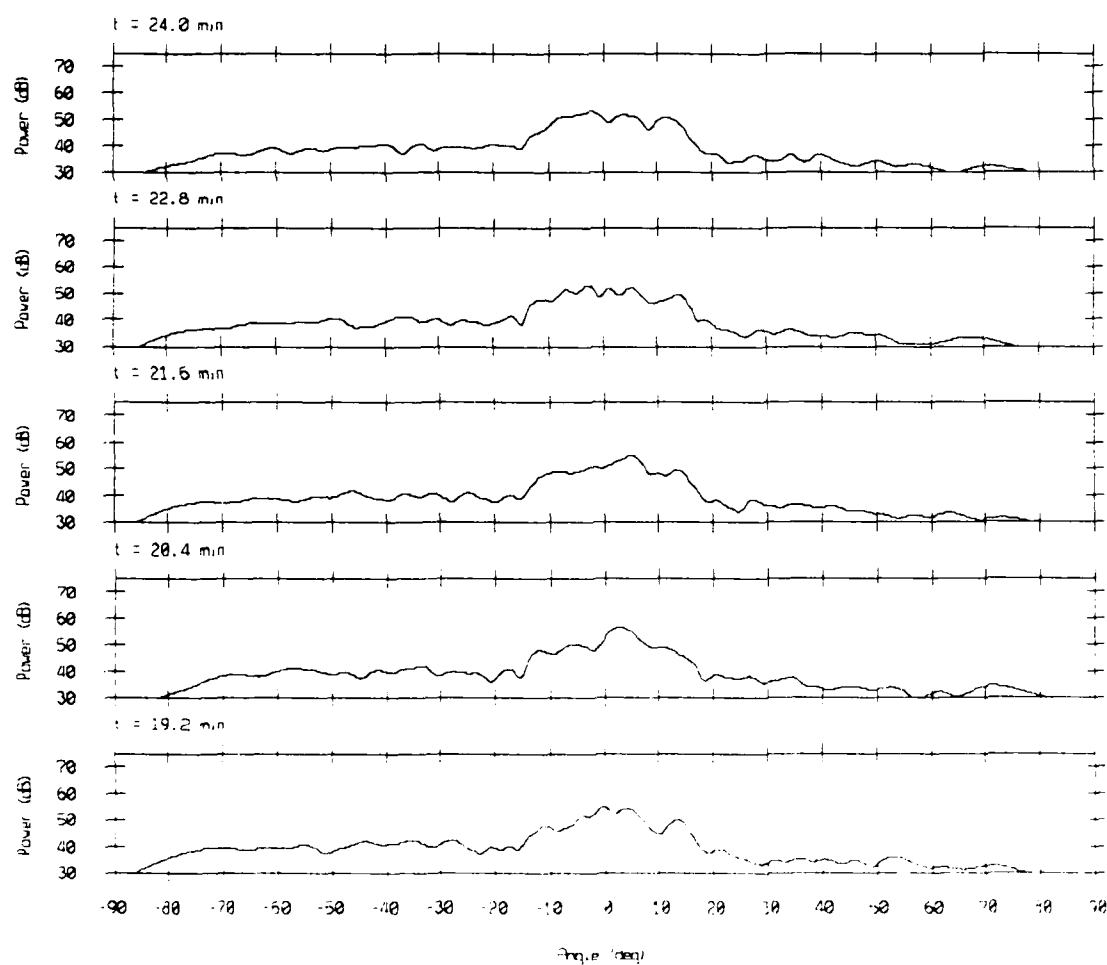
# Array Response - 85010 Bin #6303

$f = 244.45$  Hz, rect window



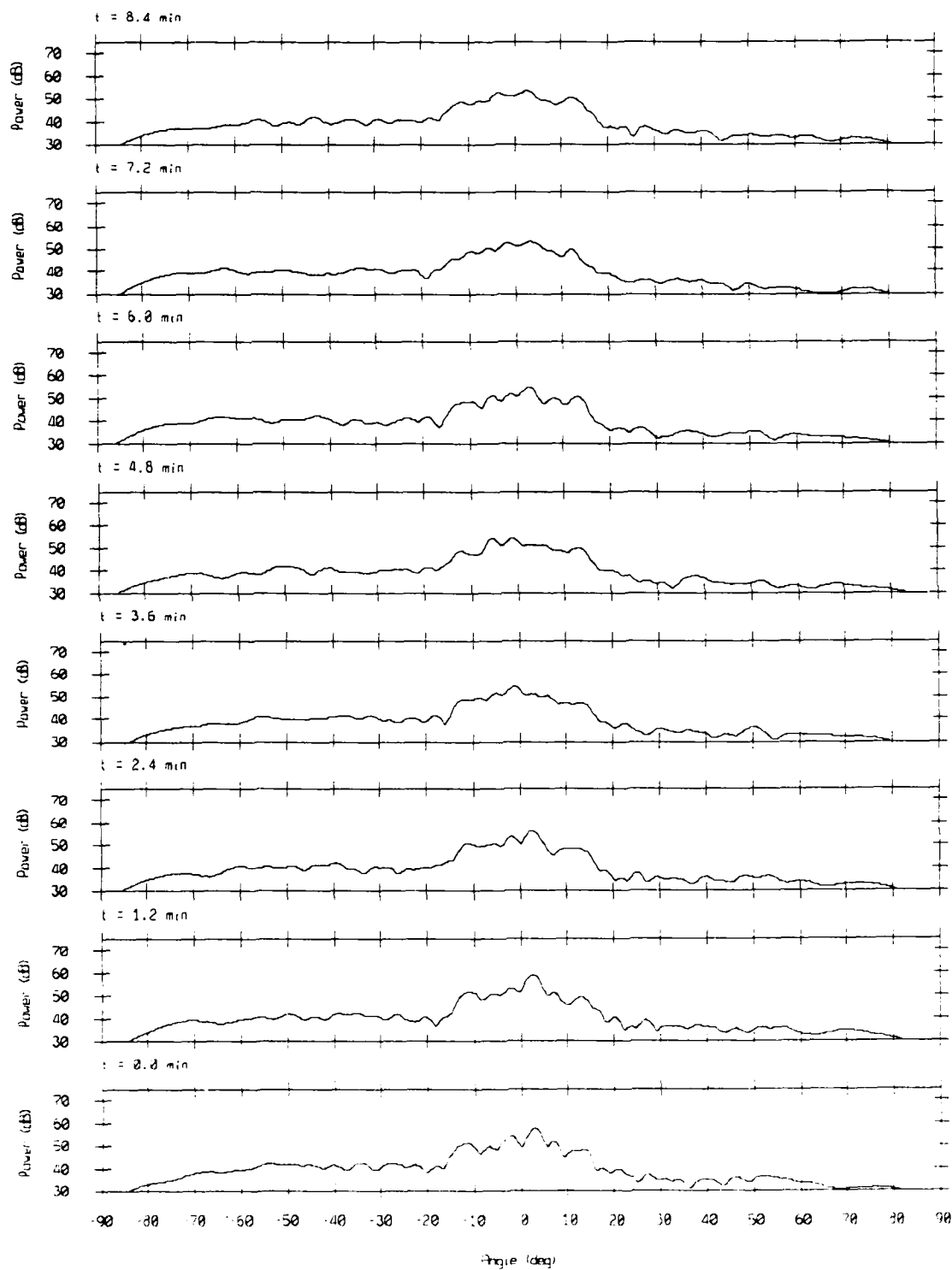
Array Response - 85010 Bin #6303

$f = 244.45$  Hz, rect window



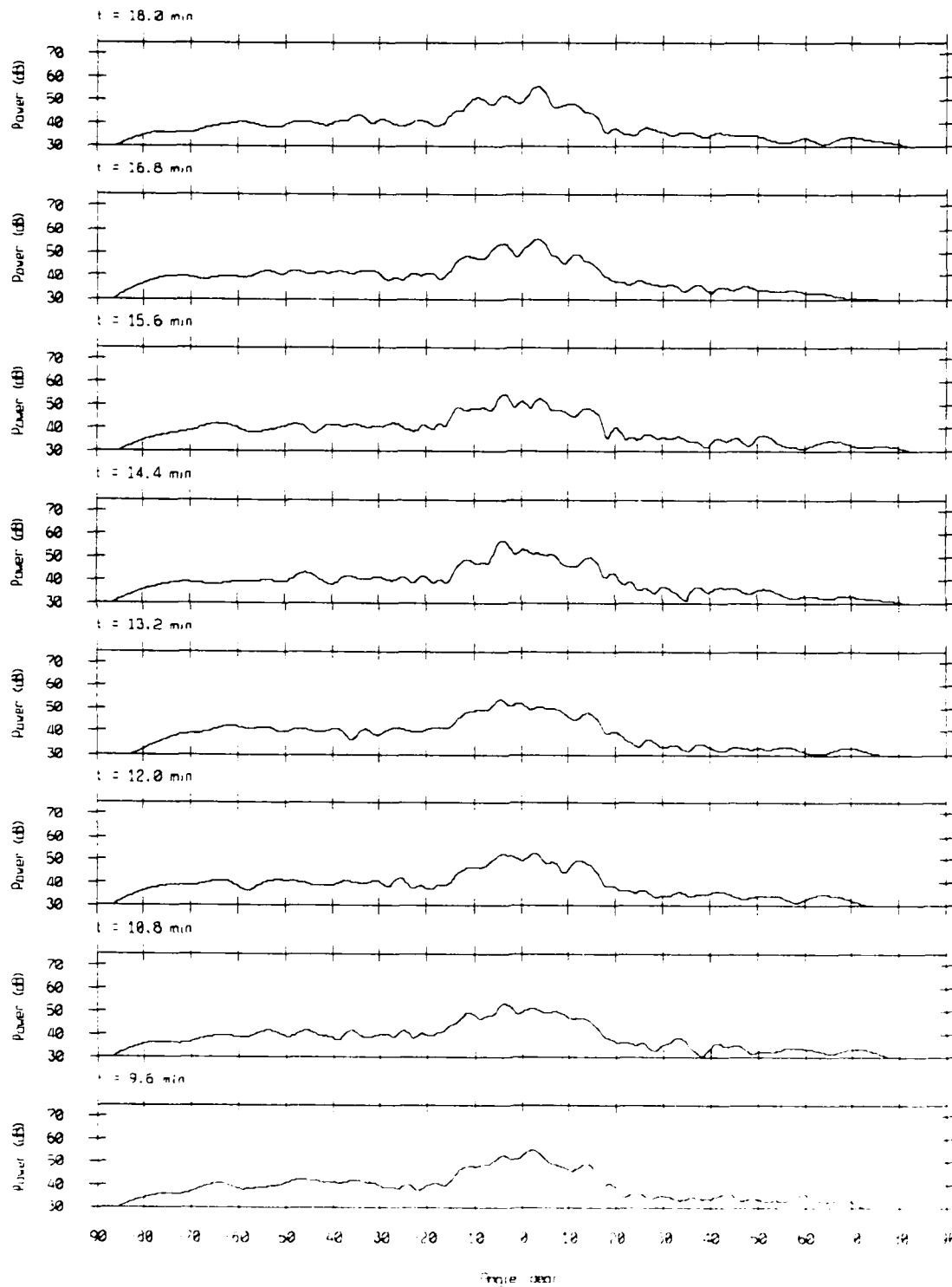
# Array Response - 85010 Bin #6304

$f = 244.45$  Hz, rect window



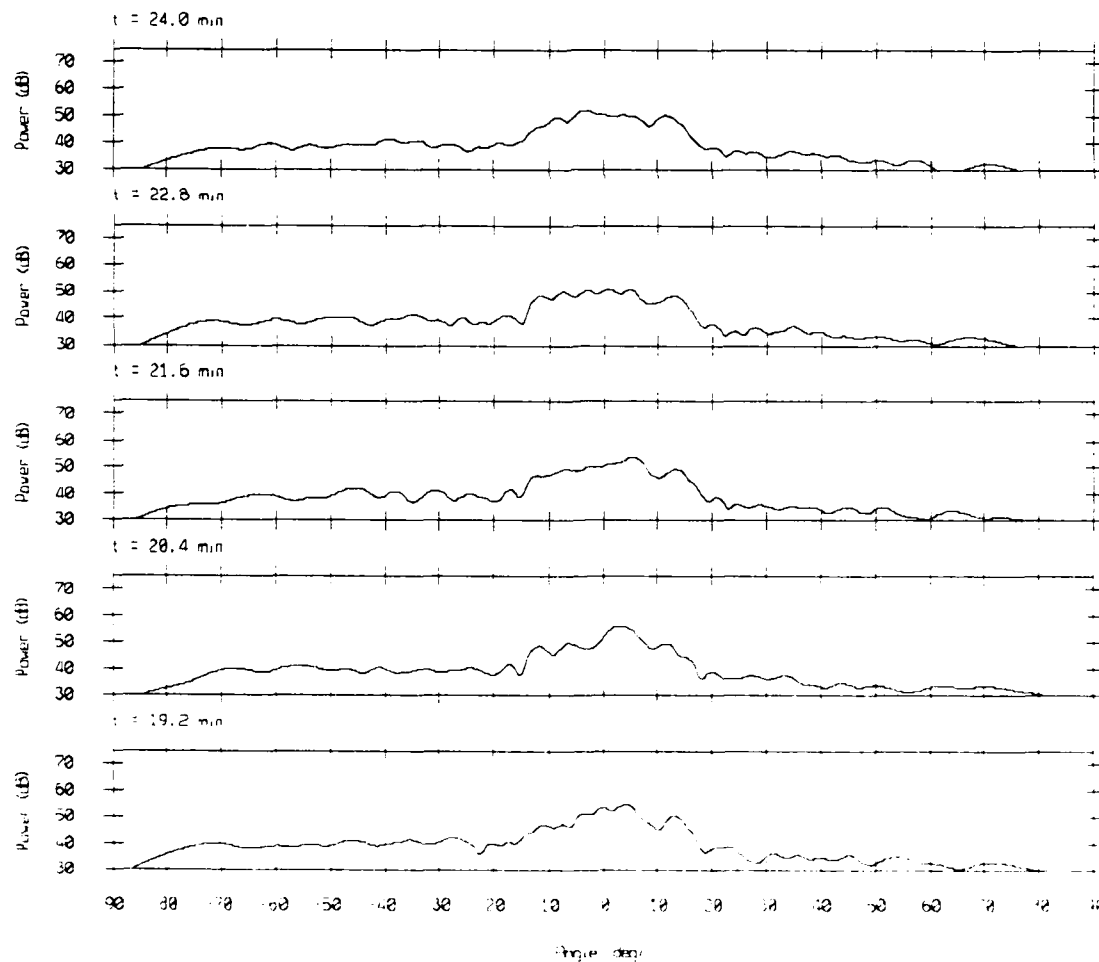
Array Response - 85010 Bin #6304

$f = 244.45$  Hz, rect window



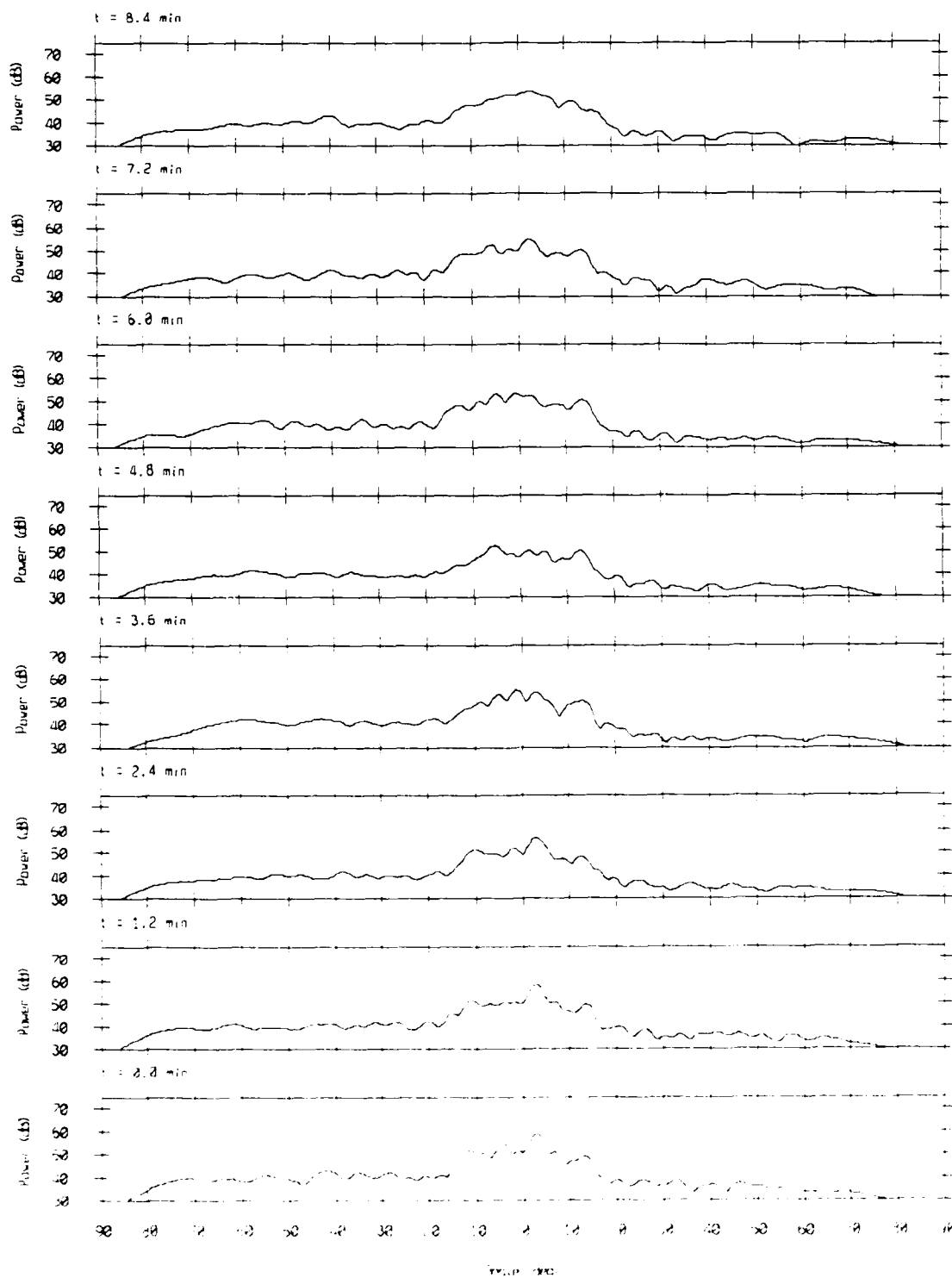
Array Response - 85010 Bin #6304

$f = 244.45$  Hz, rect window



Array Response - 85010 Bin #6309

$f = 245.12$  Hz, rect window



VERTICAL SIGNAL ARRIVAL STRUCTURE(U) SCRIPPS  
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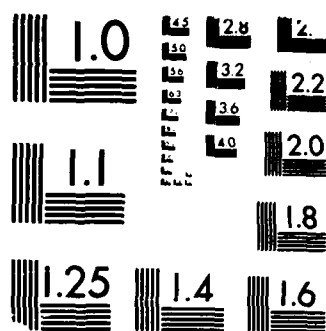
LAB. M. S. HODGKISS ET AL. JAN 88 MPL-TM-399

NO0014-84-K-0097

F/G 20/1

NL

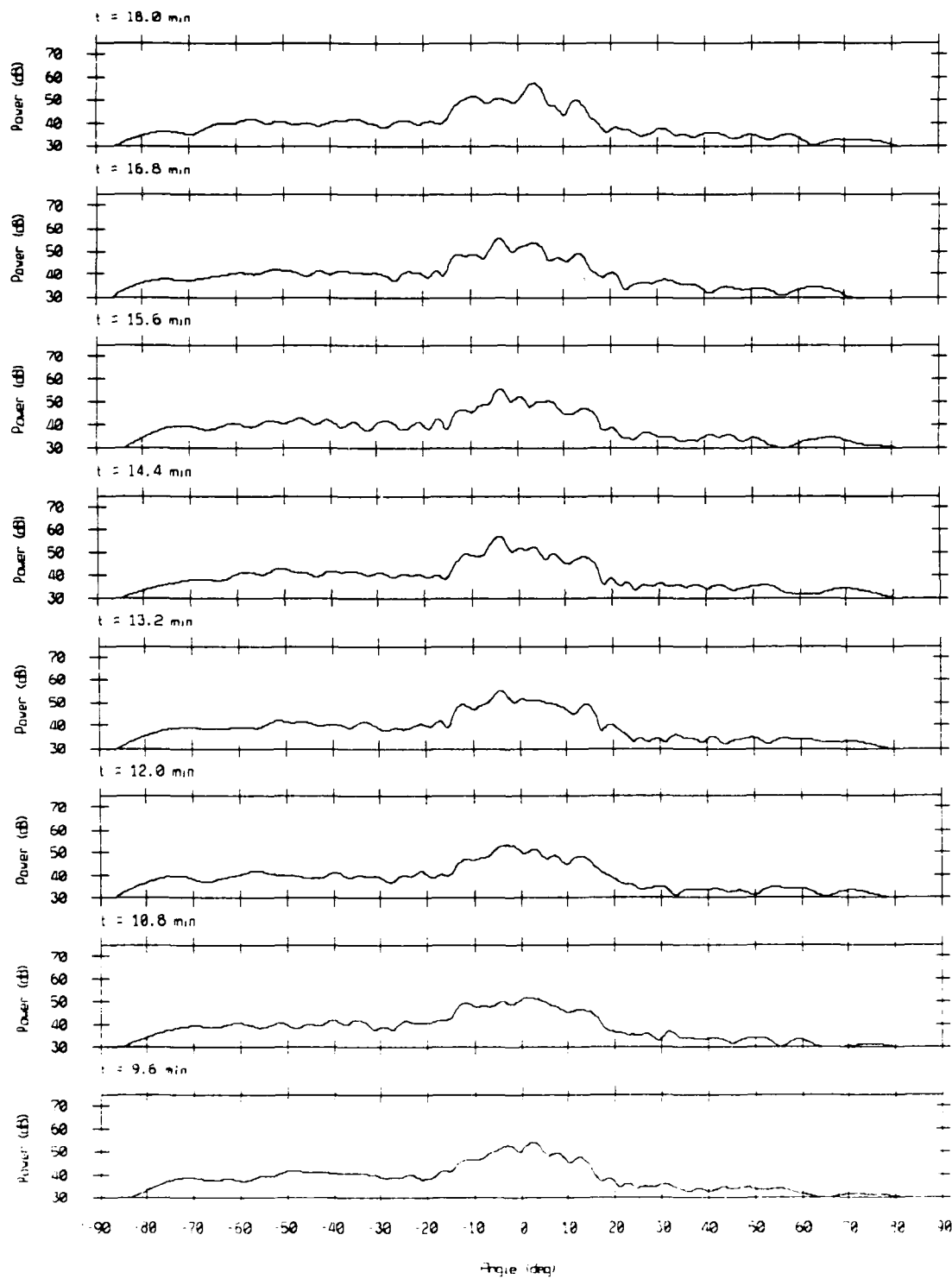
[illegible]



MICROCOPY RESOLUTION TEST CHART  
 NATIONAL BUREAU OF STANDARDS-1963-A

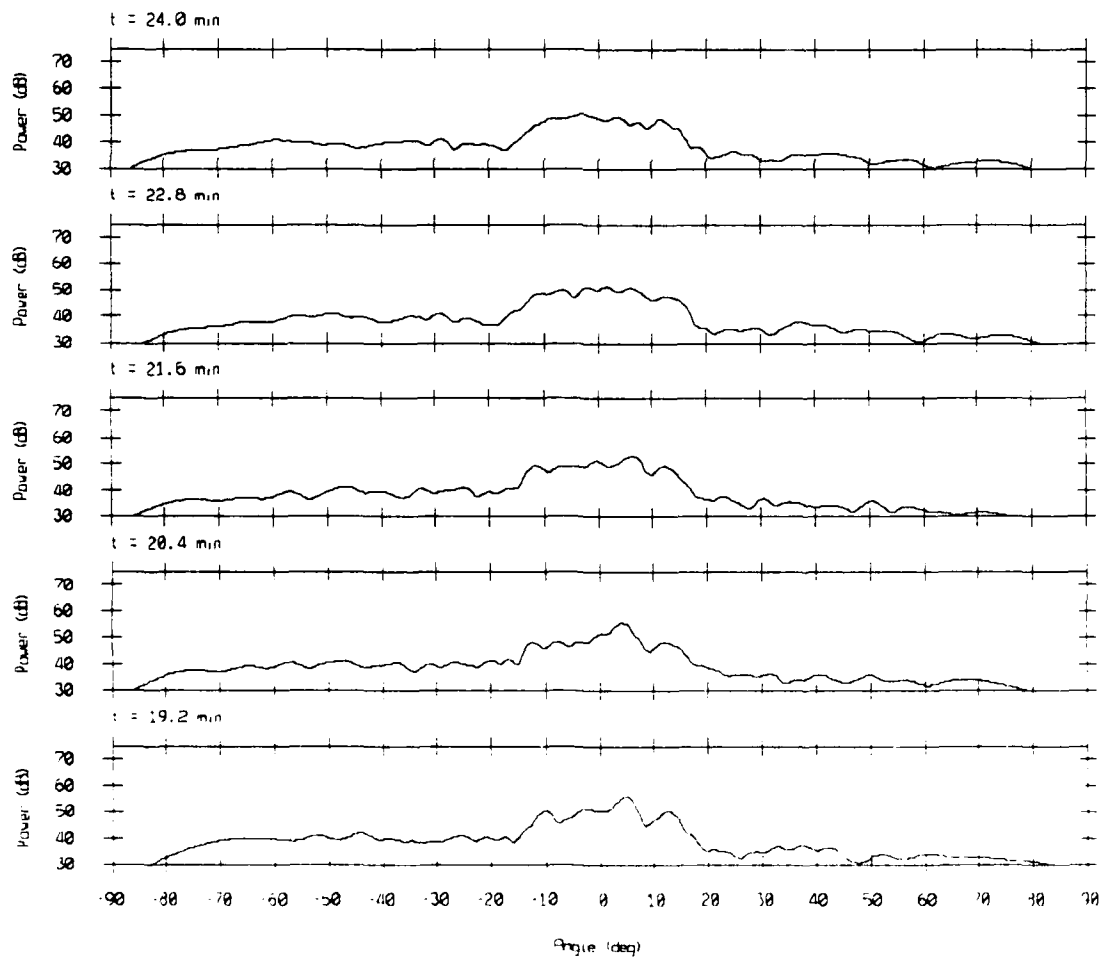
Array Response - 85010 Bin #6309

$f = 245.12$  Hz, rect window



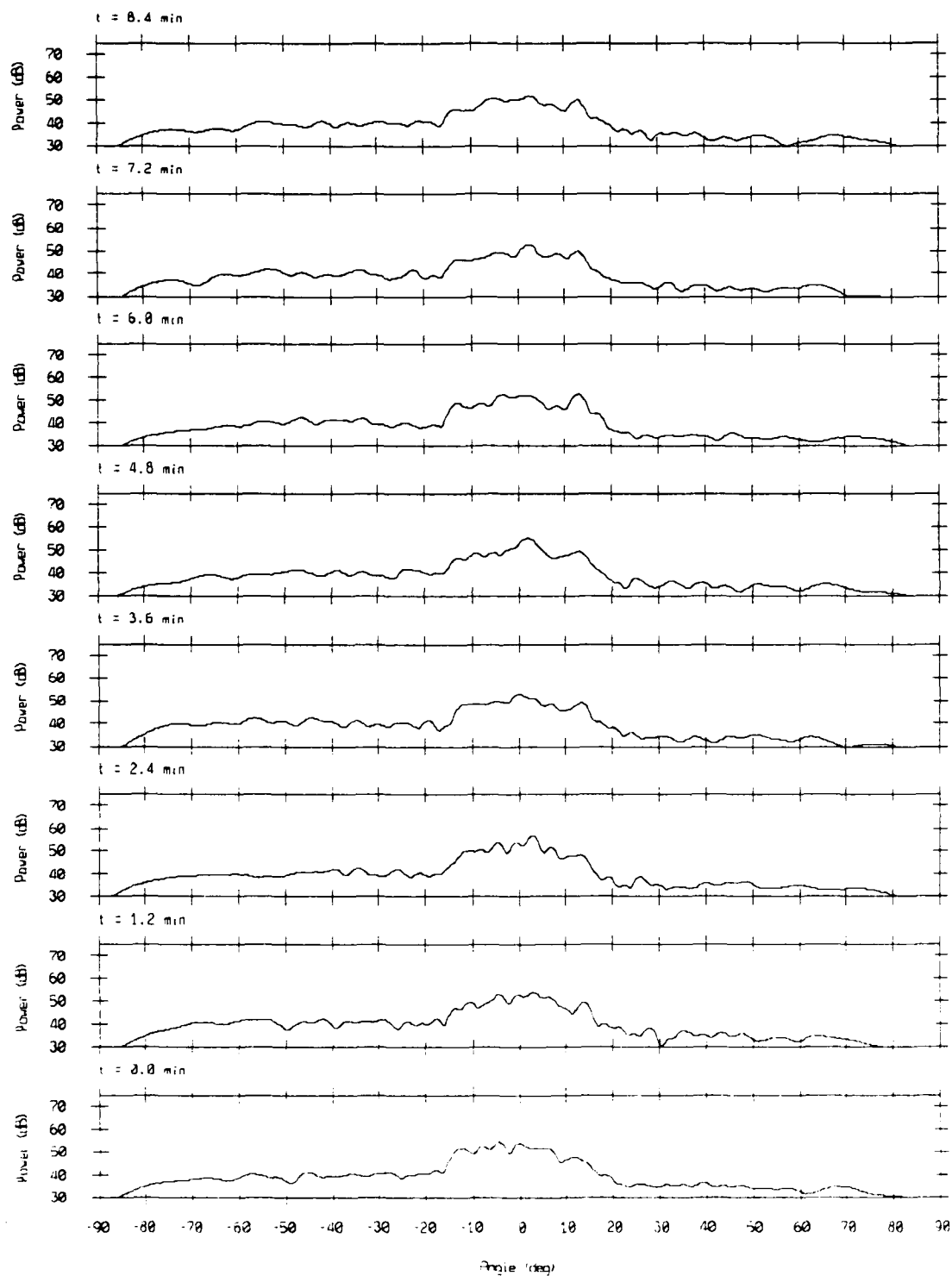
Array Response - 85010 Bin #6309

$f = 245.12$  Hz, rect window



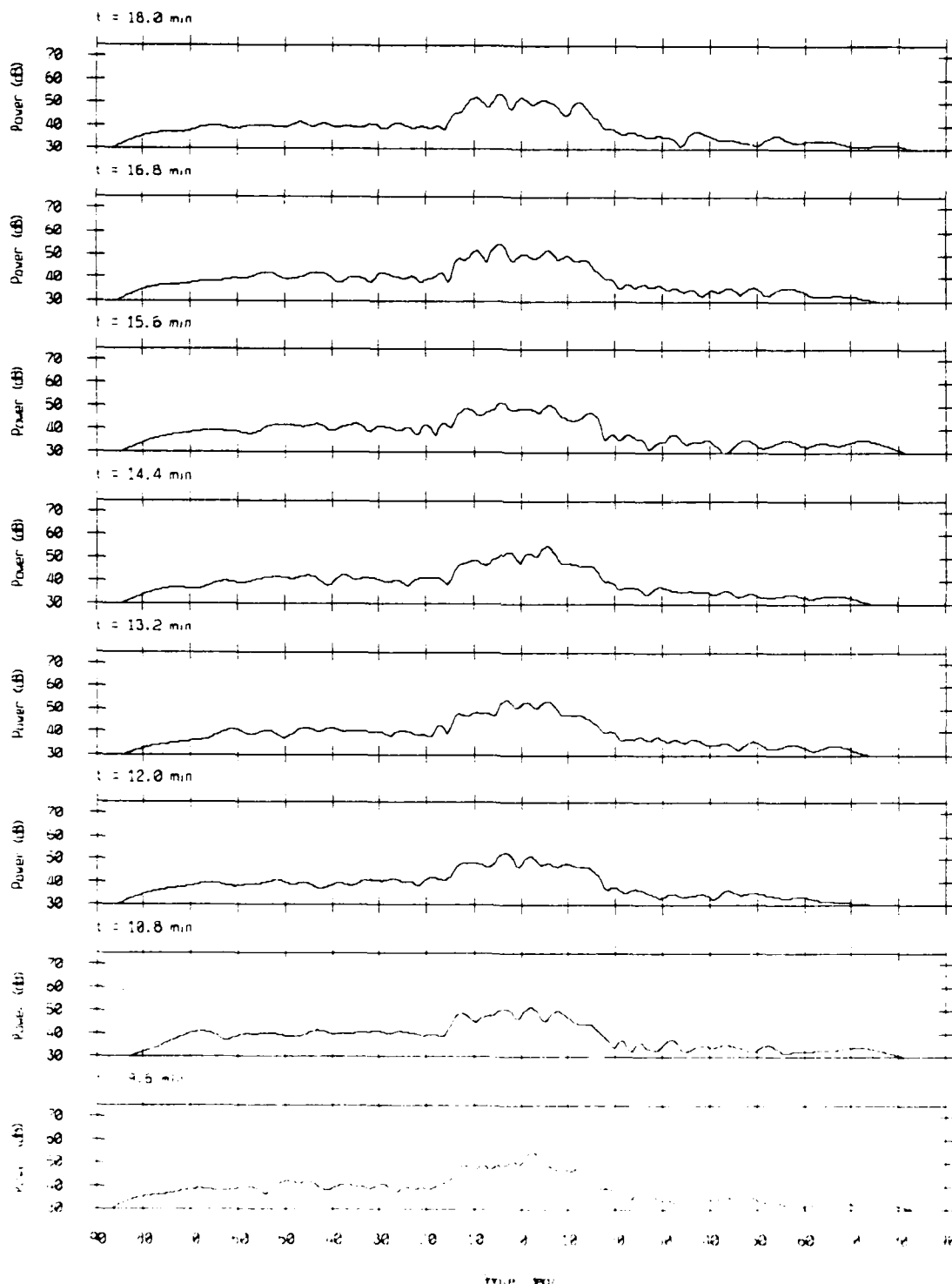
Array Response - 85010 Bin #6343

$f = 248.88$  Hz, rect window



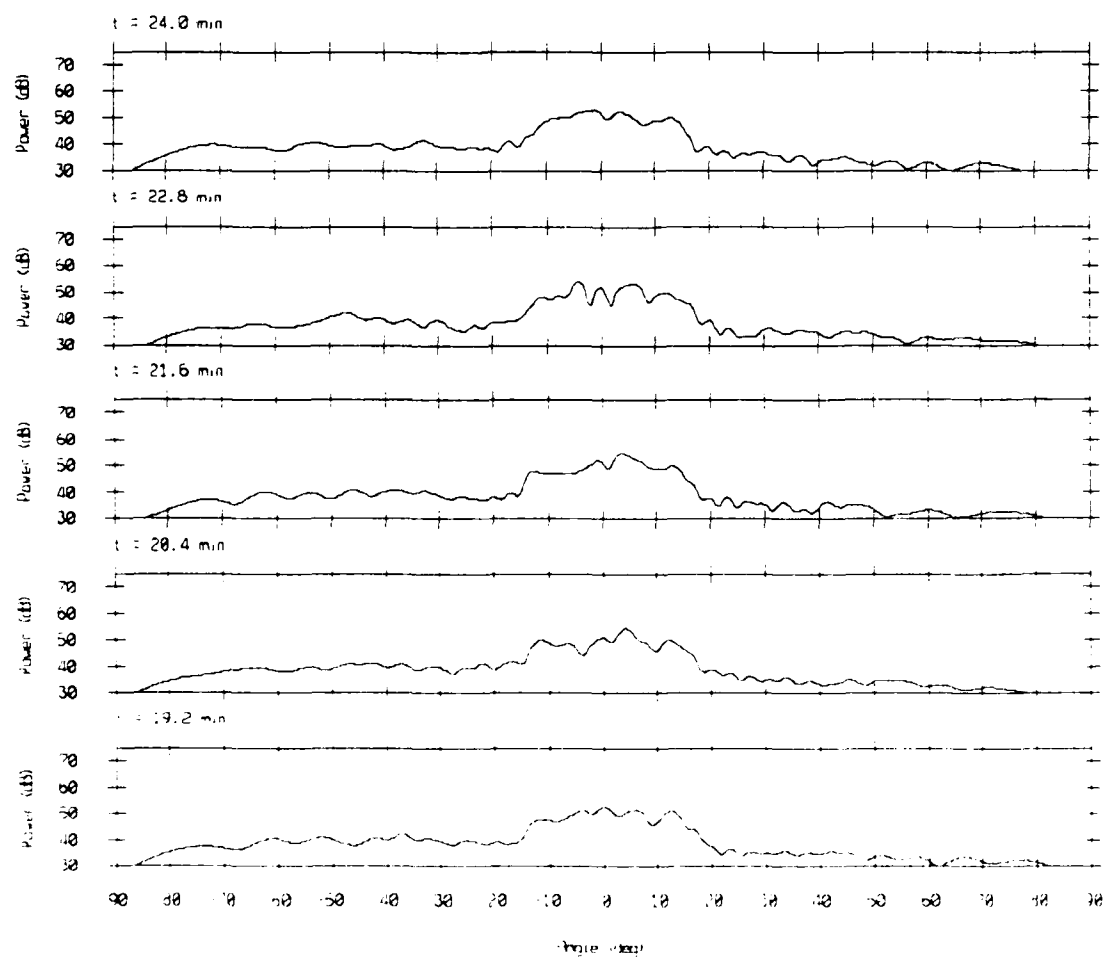
Array Response - 85010 Bin #6343

$f = 248.88$  Hz, rect window



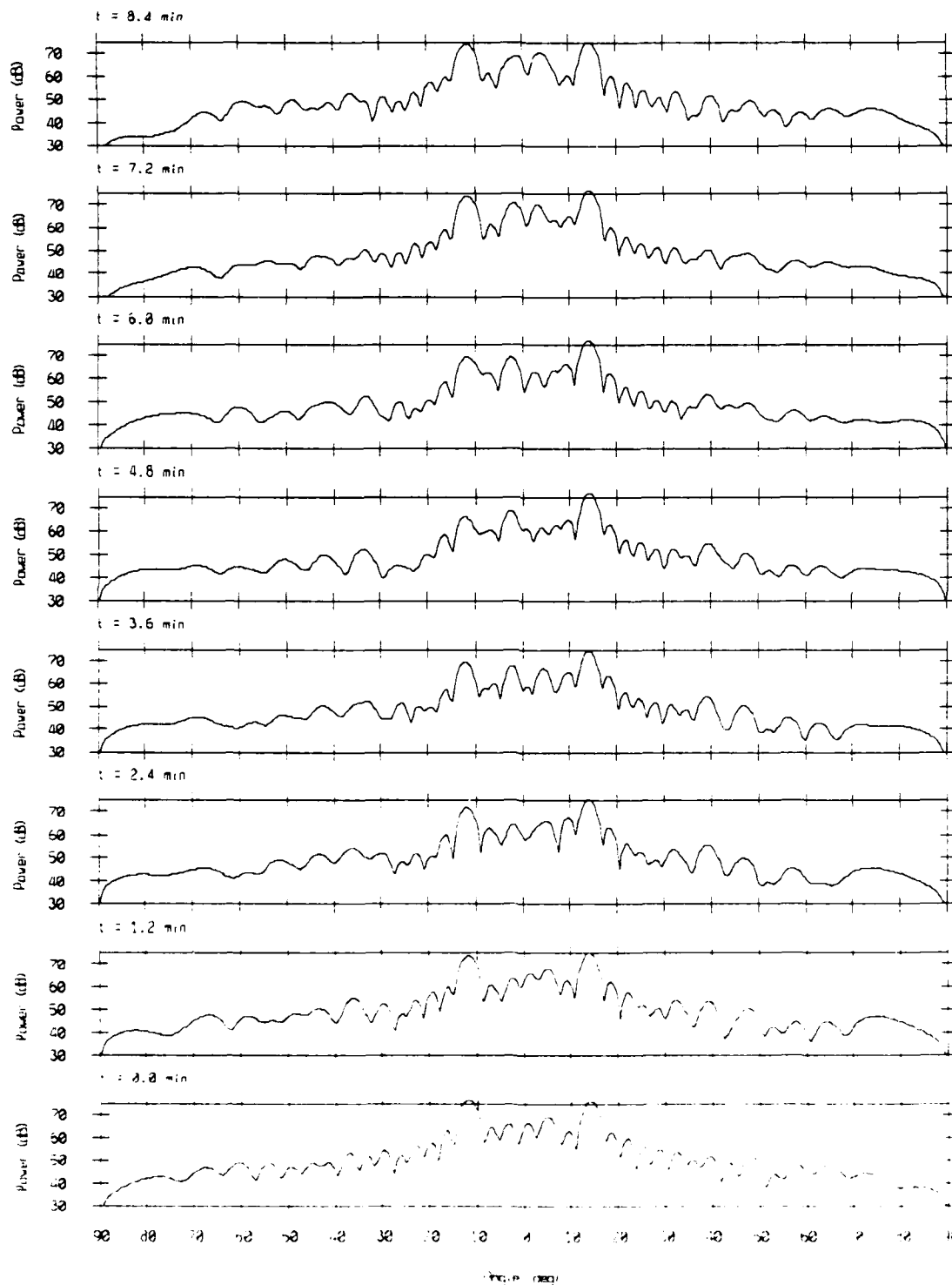
Array Response - 85010 Bin #6343

$f = 248.88$  Hz, rect window



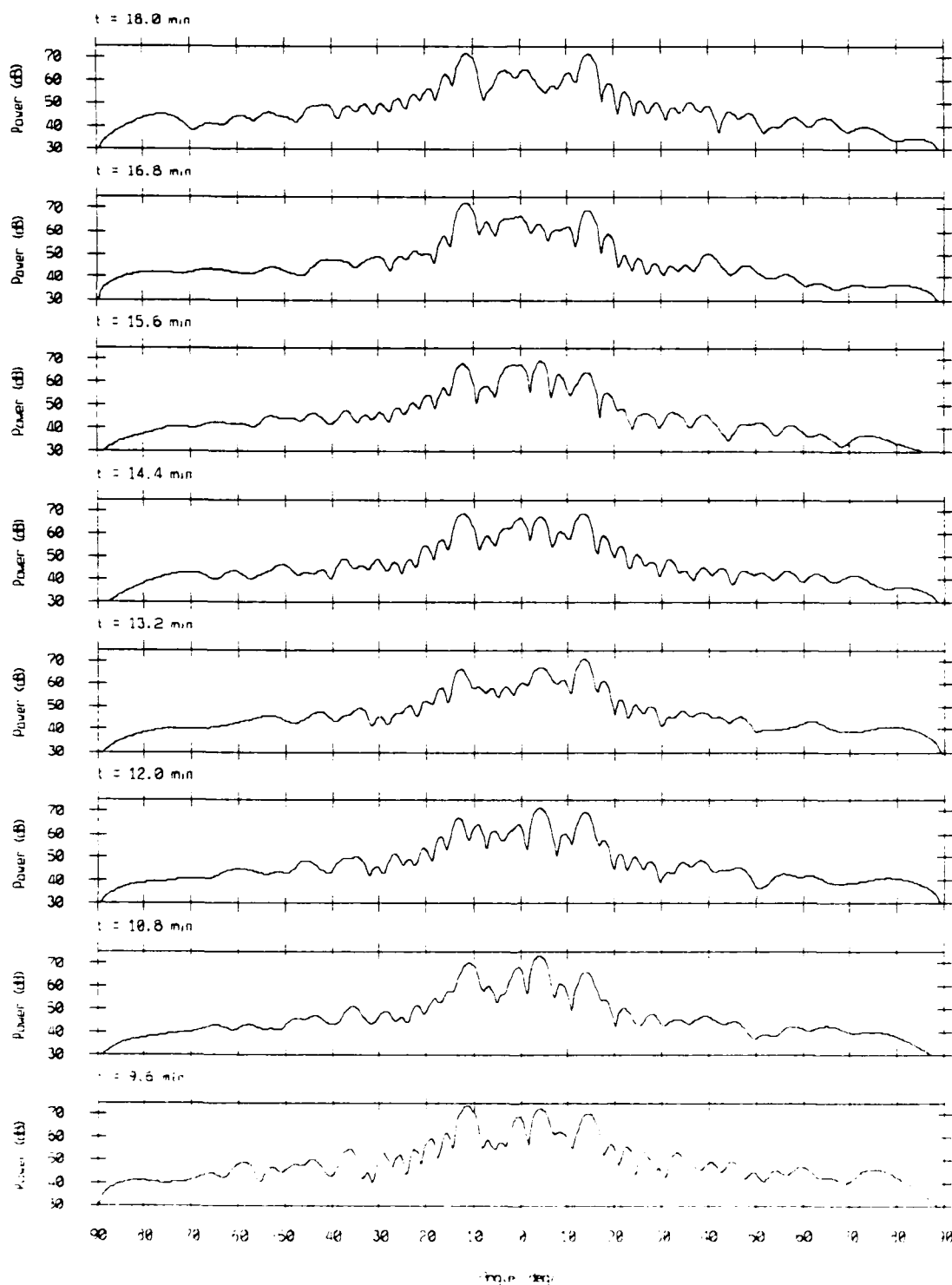
Array Response - 85010 Bin #6348

$f = 249.44$  Hz, rect window



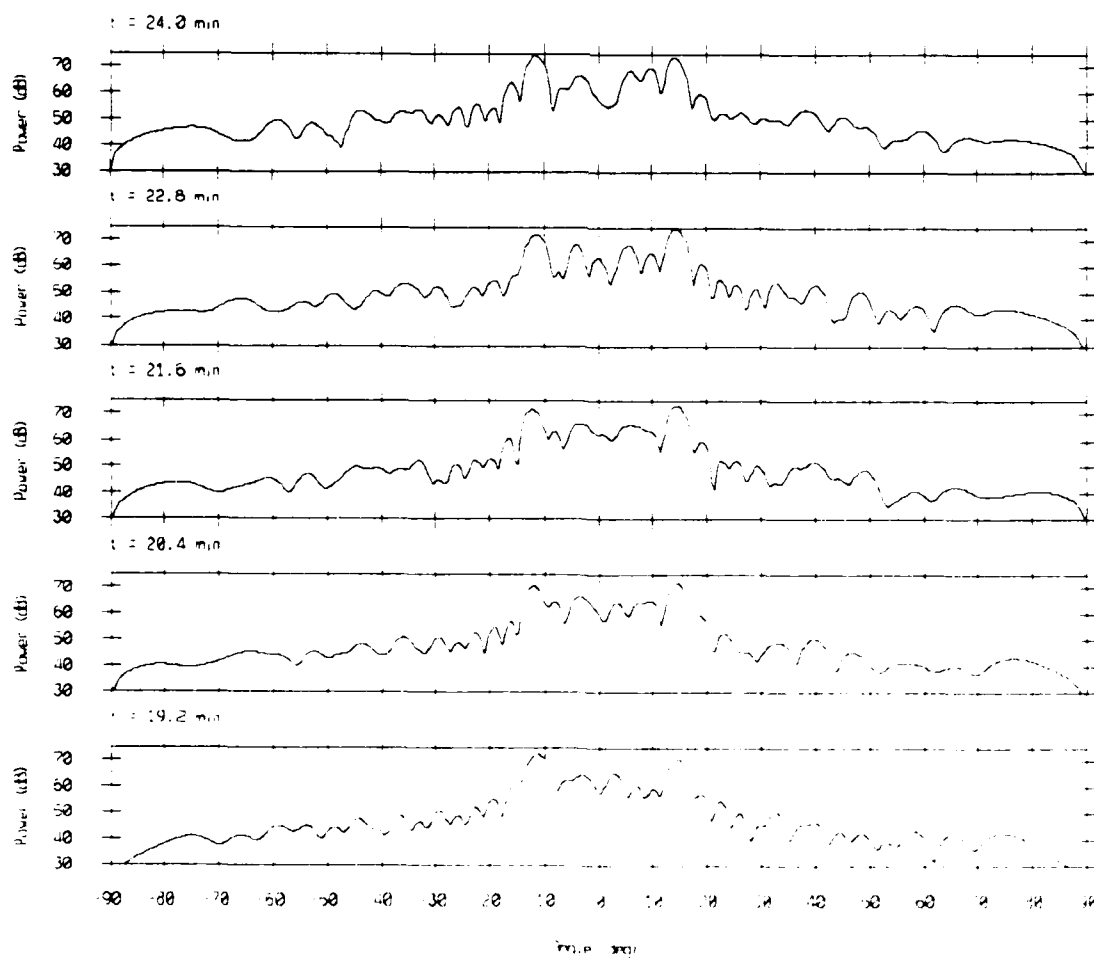
Array Response - 85010 Bin #6348

$f = 249.44$  Hz, rect window



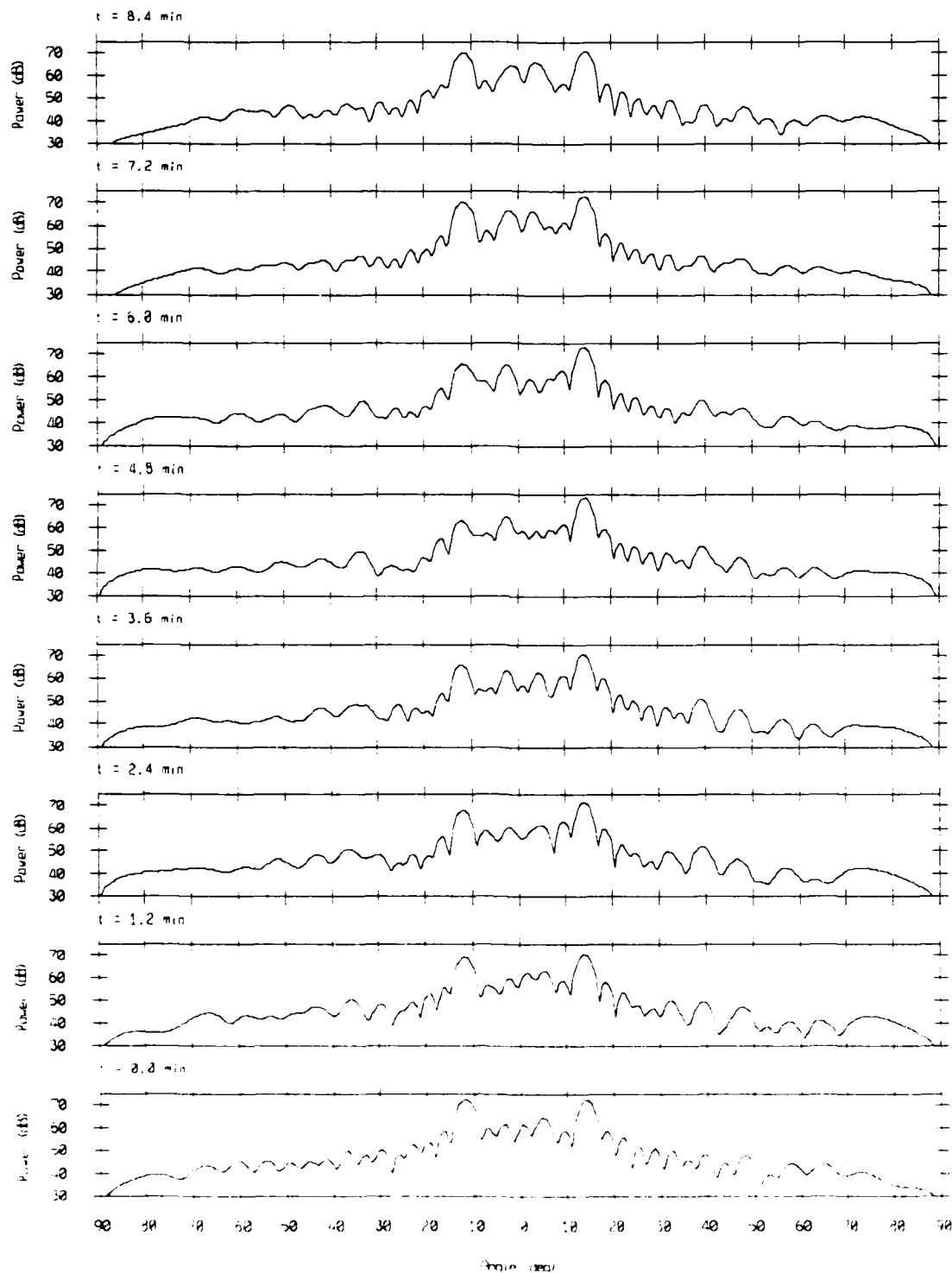
Array Response - 85010 Bin #6348

$f = 249.44$  Hz, rect window



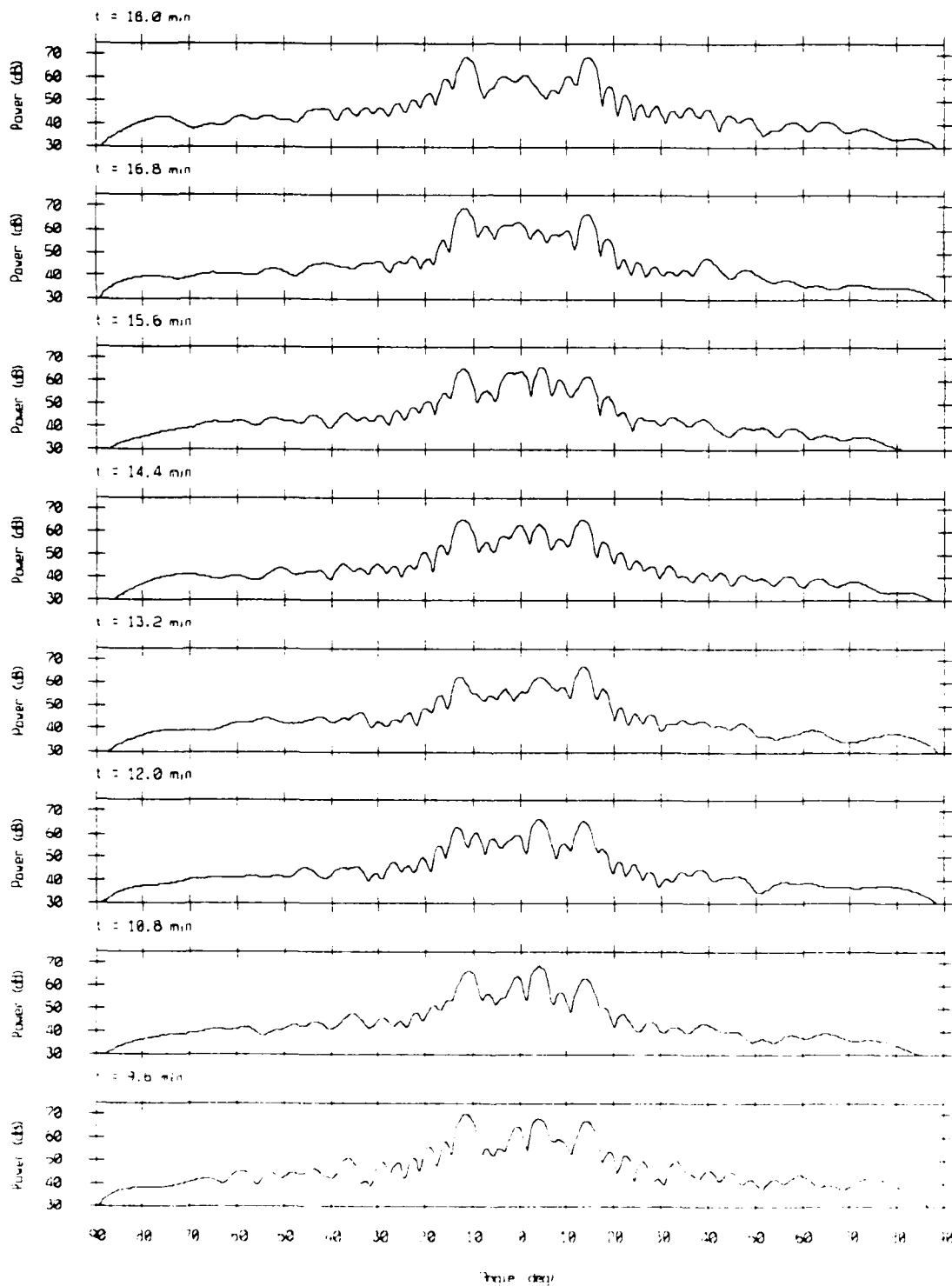
Array Response - 85010 Bin #6349

$f = 249.44$  Hz, rect window



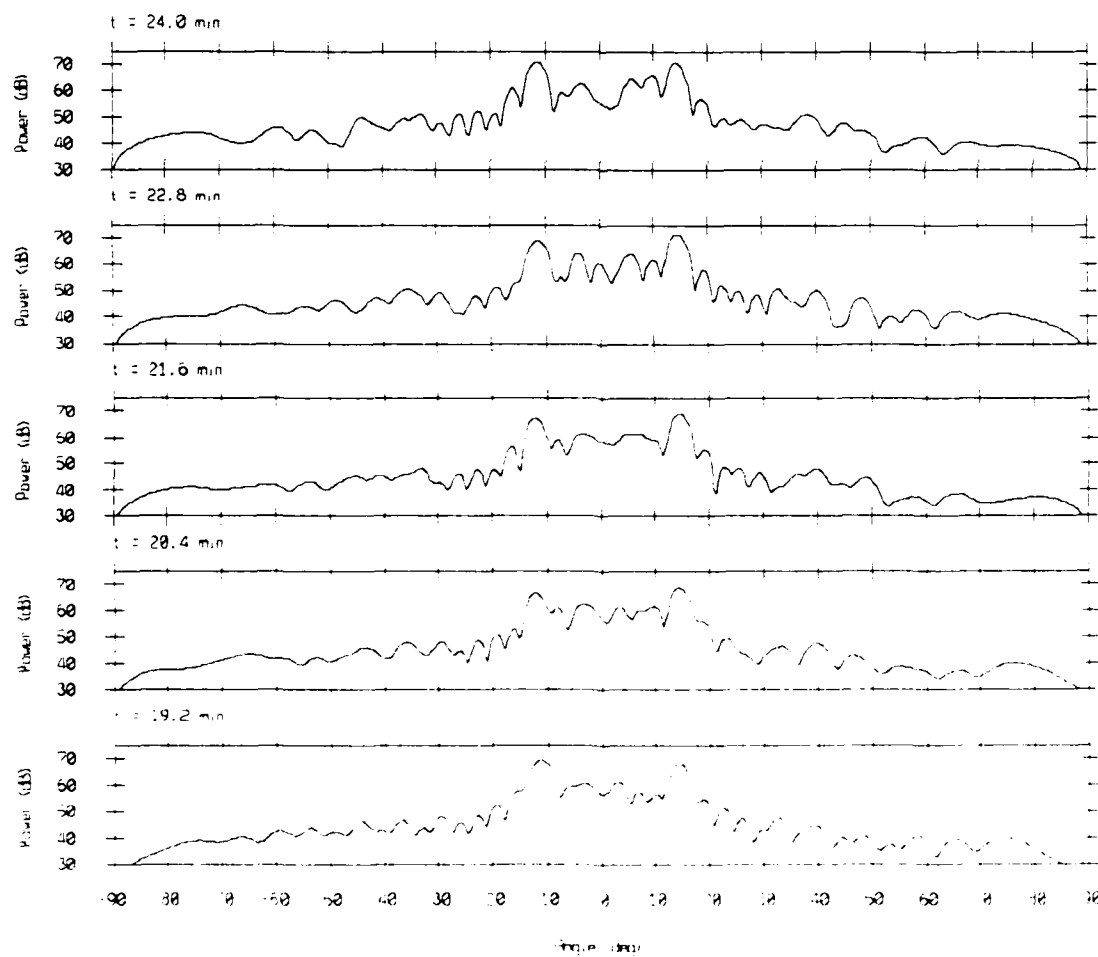
Array Response - 85010 Bin #6349

$f = 249.44$  Hz, rect window



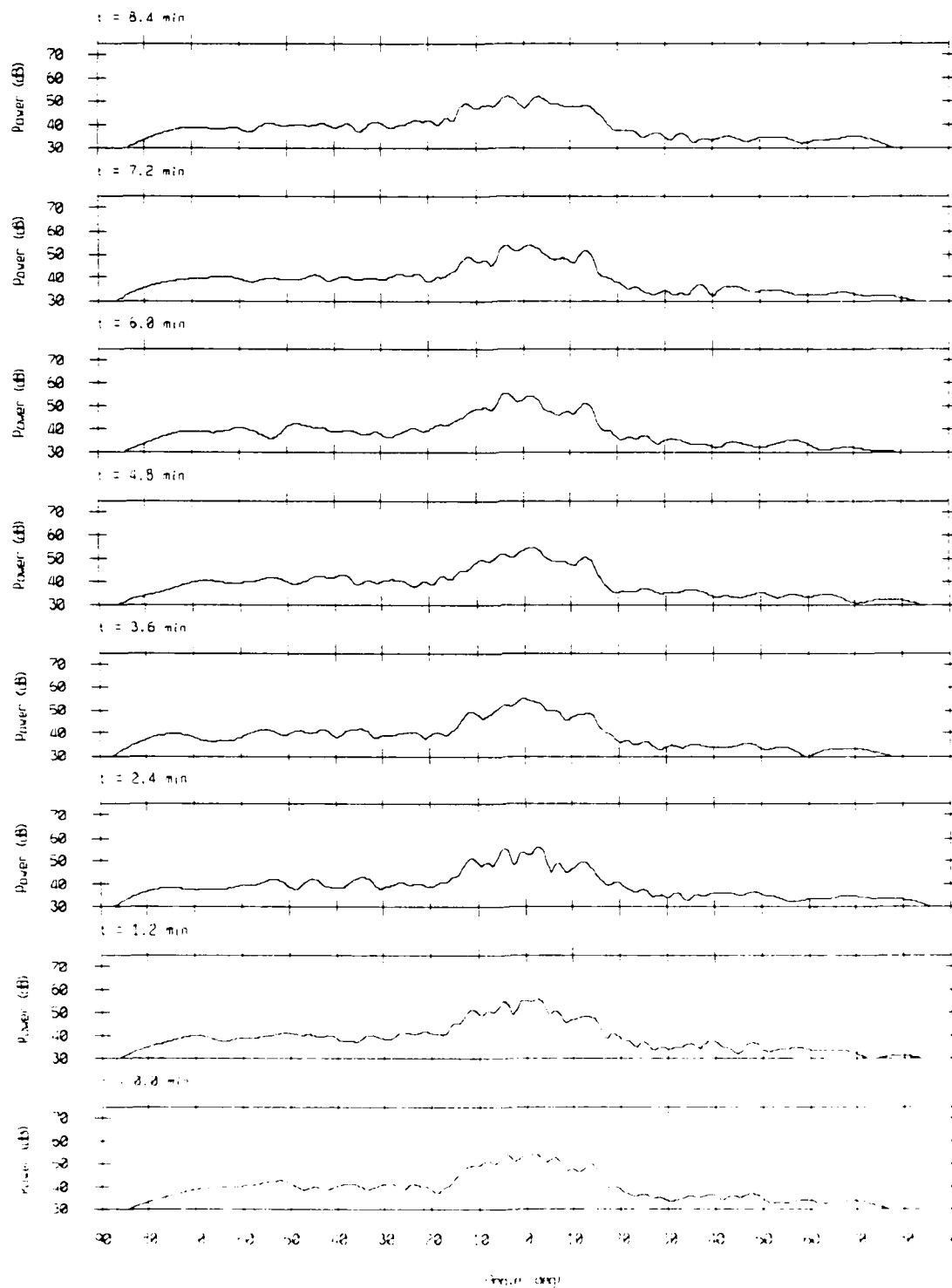
Array Response - 85010 Bin #6349

$f = 249.44$  Hz, rect window



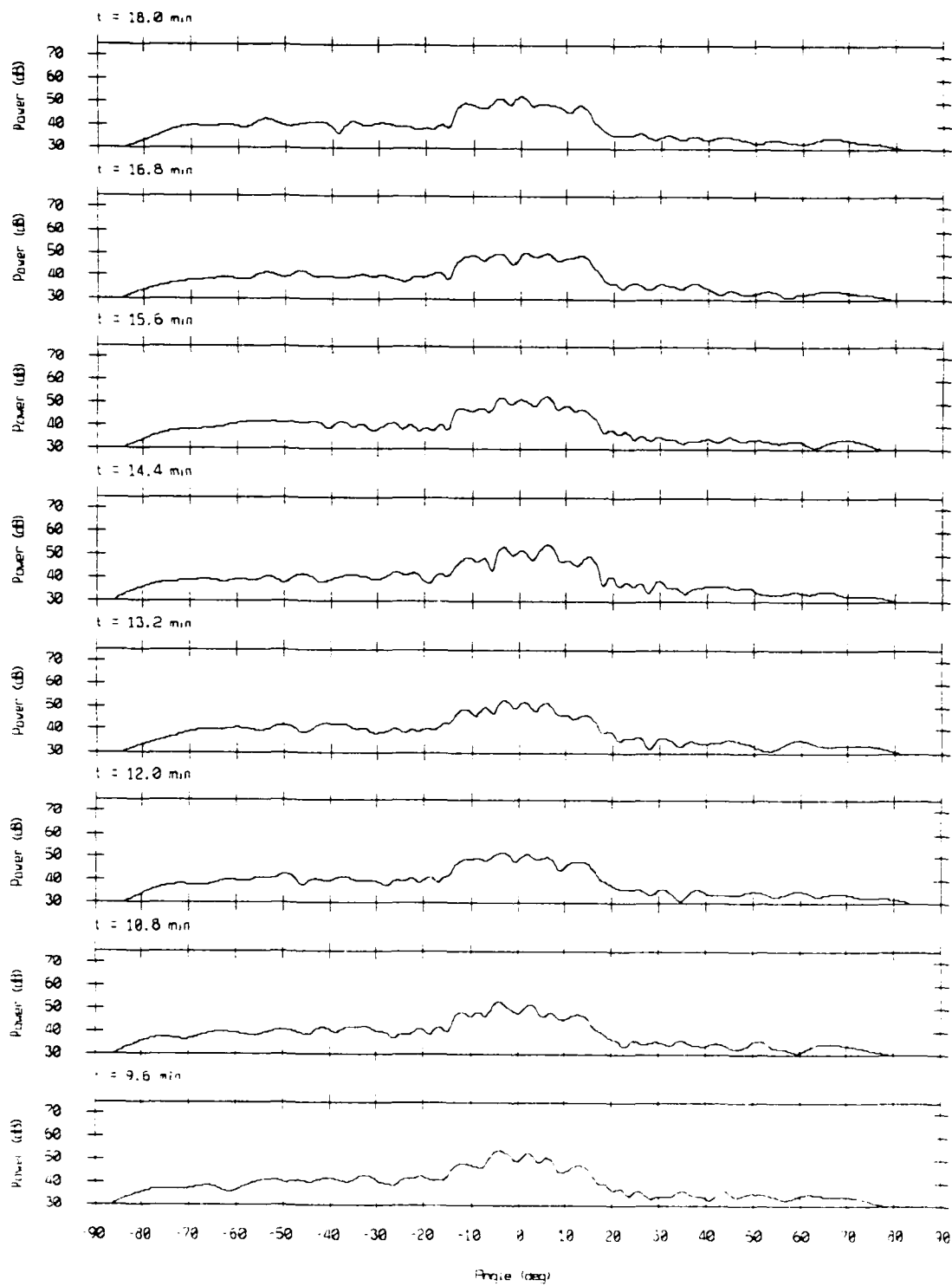
Array Response - 85010 Bin #6354

$f = 250.10$  Hz, rect window



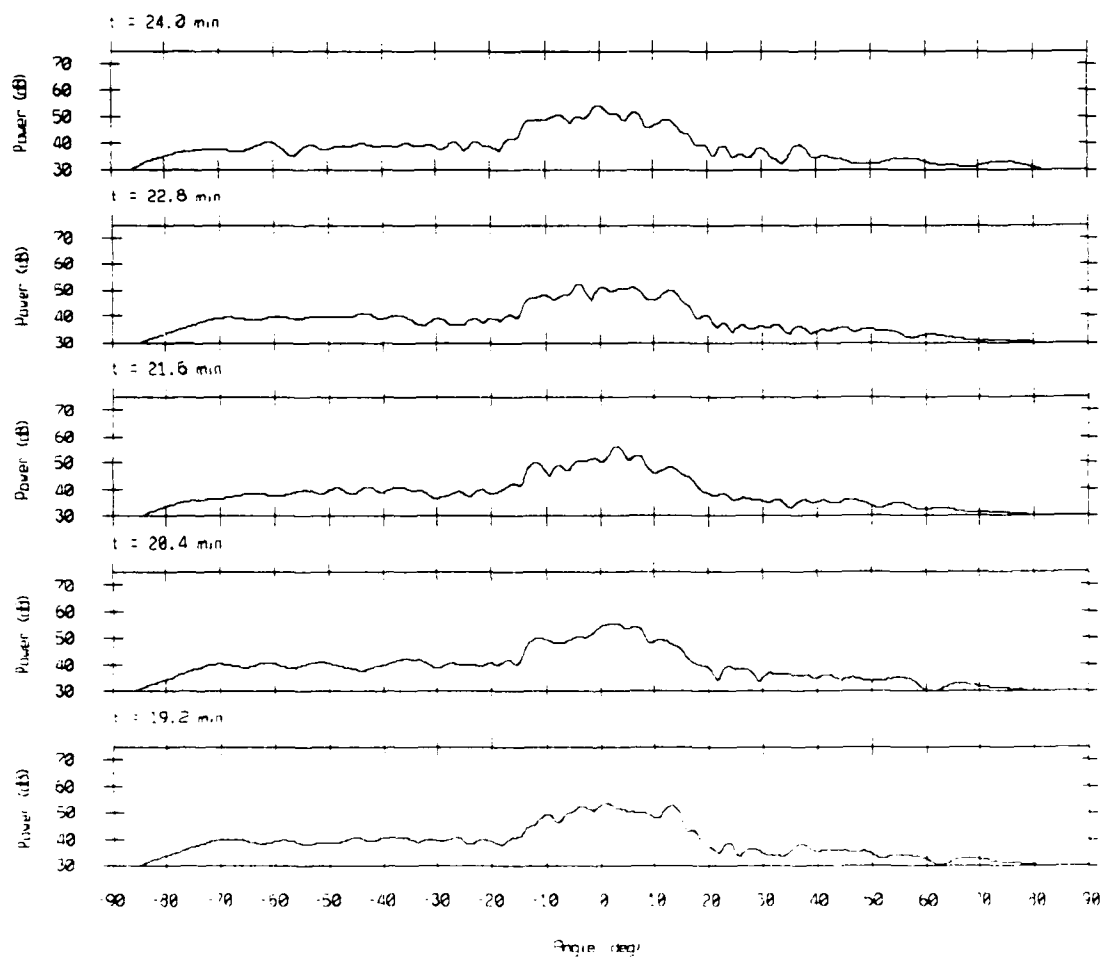
Array Response - 85010 Bin #6354

$f = 250.10$  Hz, rect window



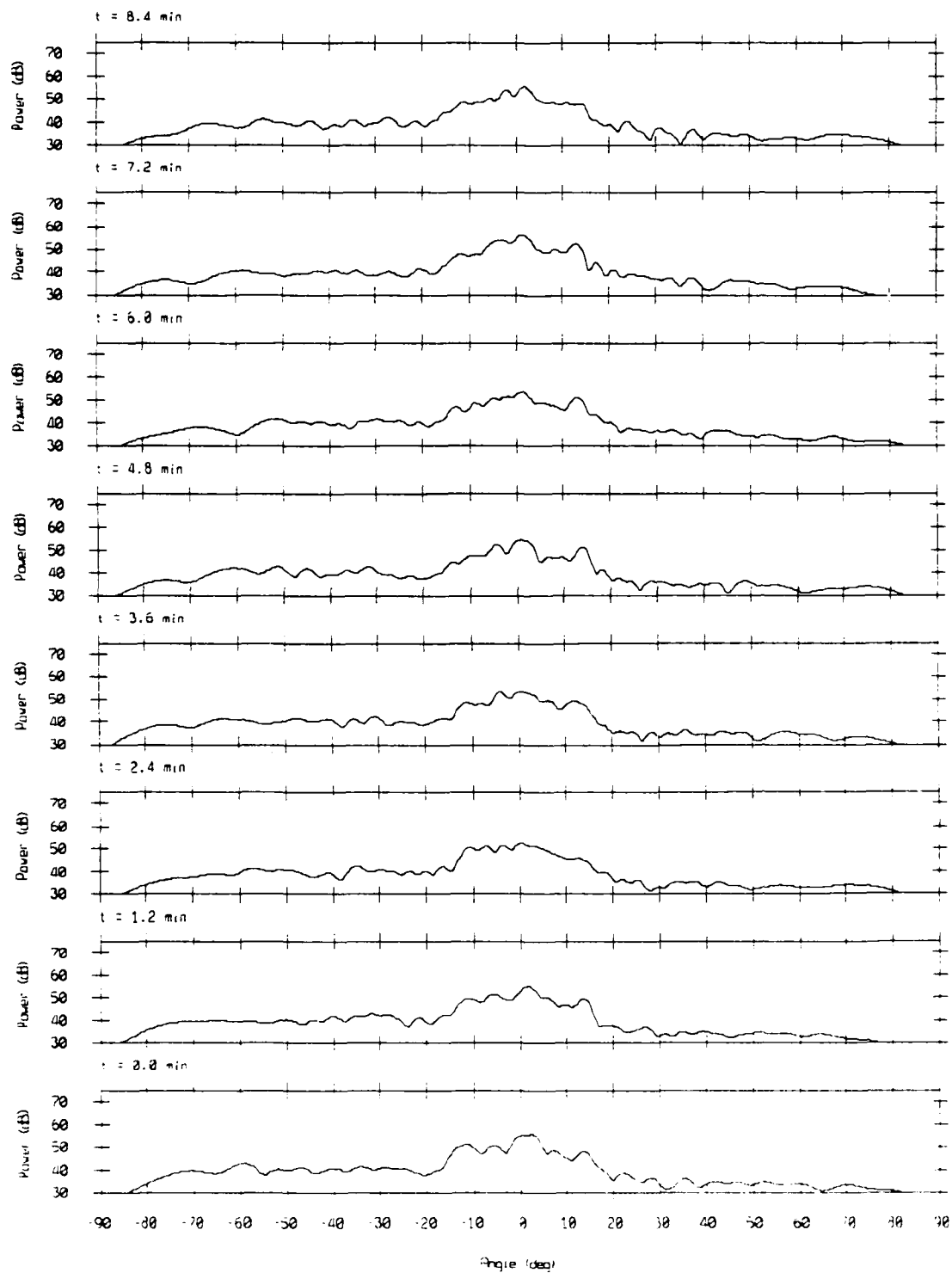
Array Response - 85010 Bin #6354

$f = 250.10$  Hz, rect window



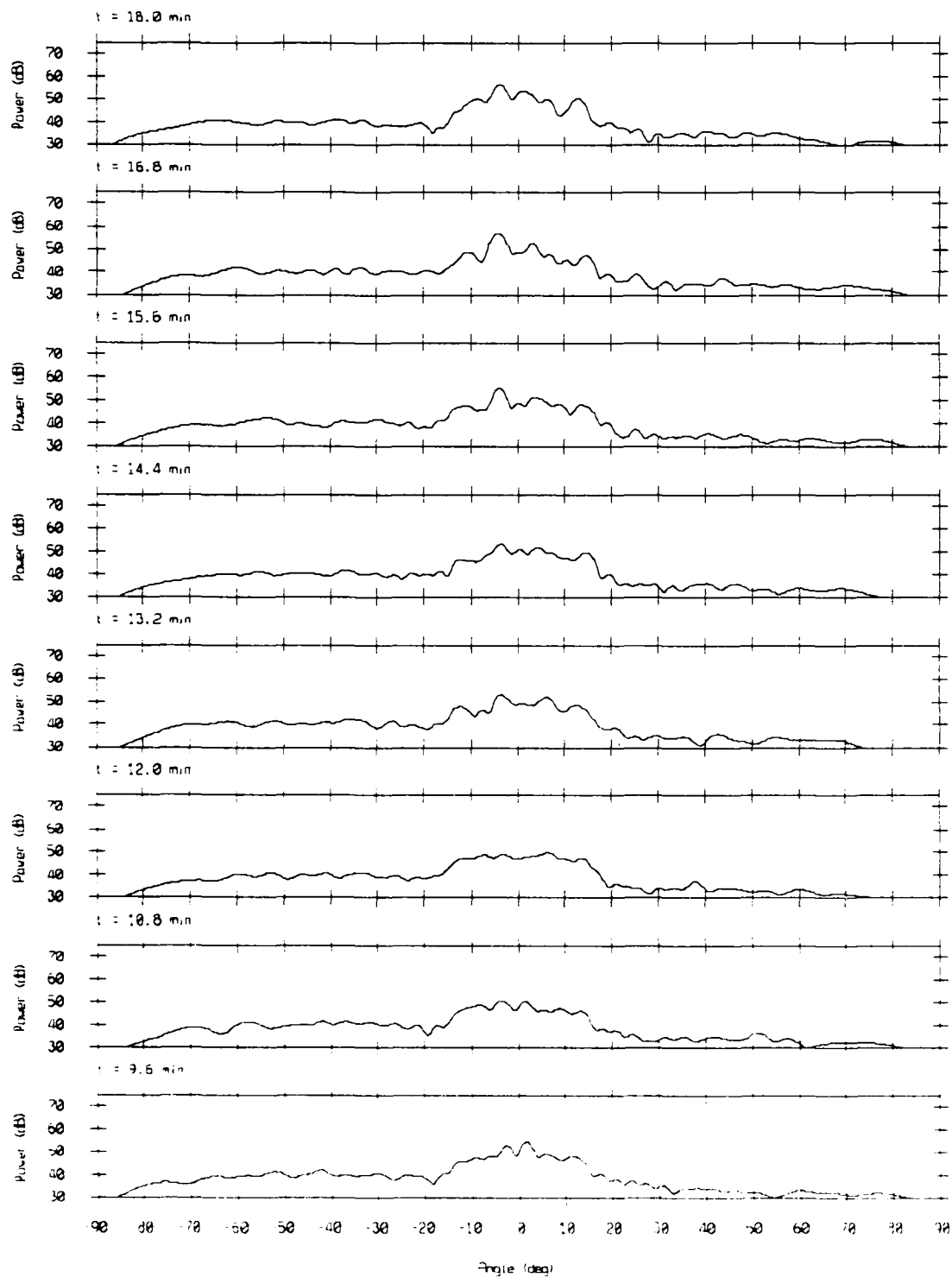
Array Response - 85010 Bin #6388

$f = 253.87$  Hz, rect window



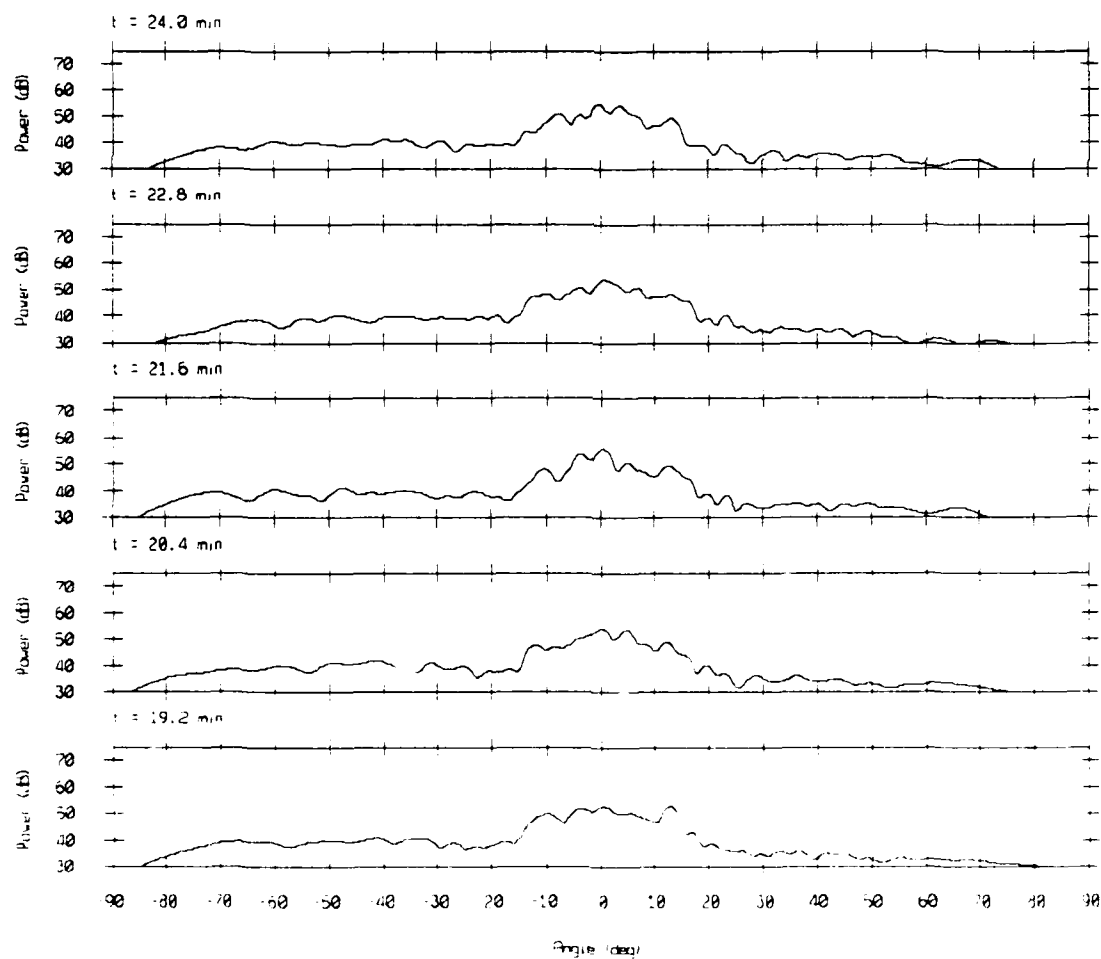
Array Response - 85010 Bin #6388

$f = 253.87$  Hz, rect window



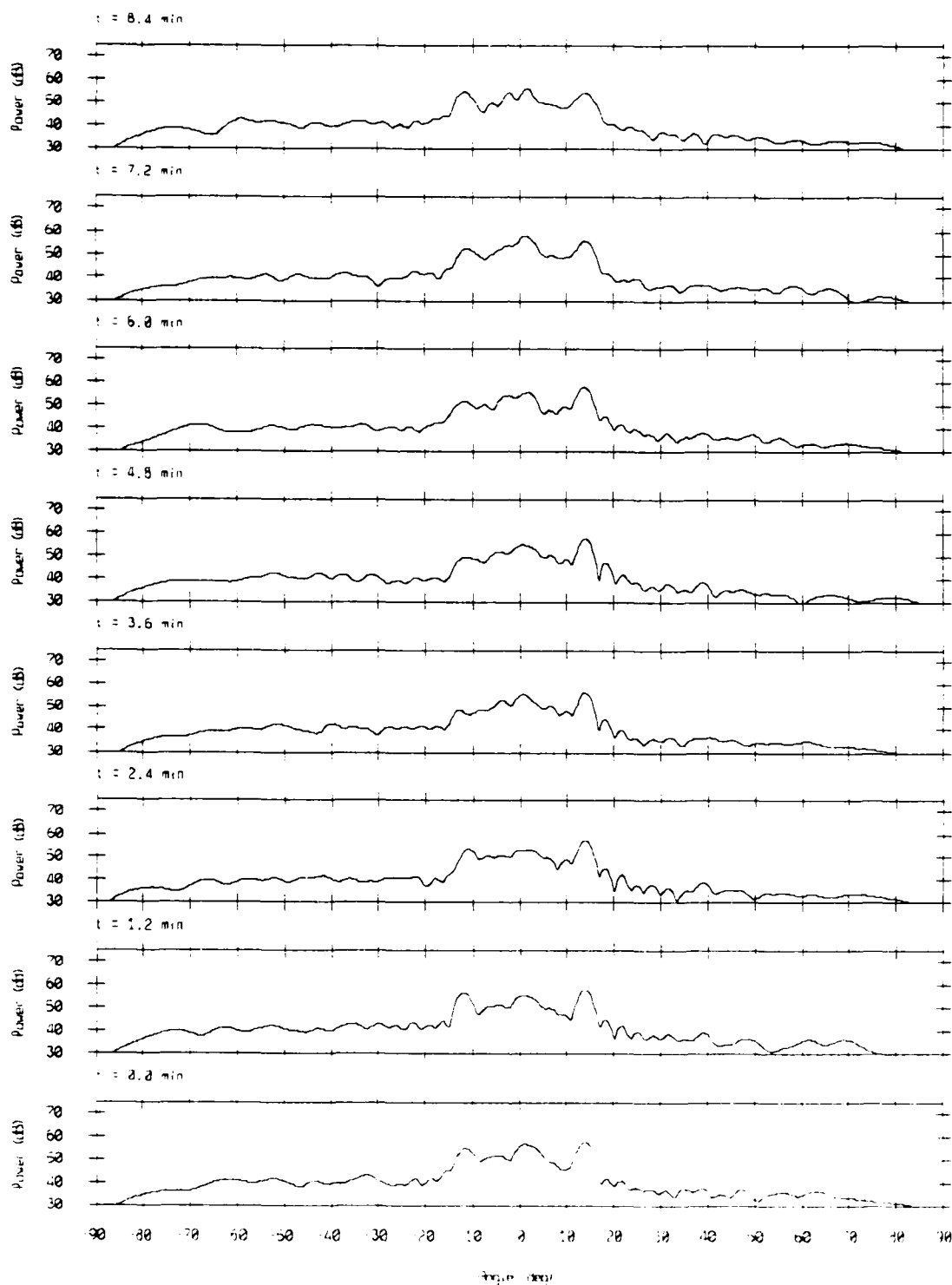
Array Response - 85010 Bin #6388

$f = 253.87$  Hz, rect window



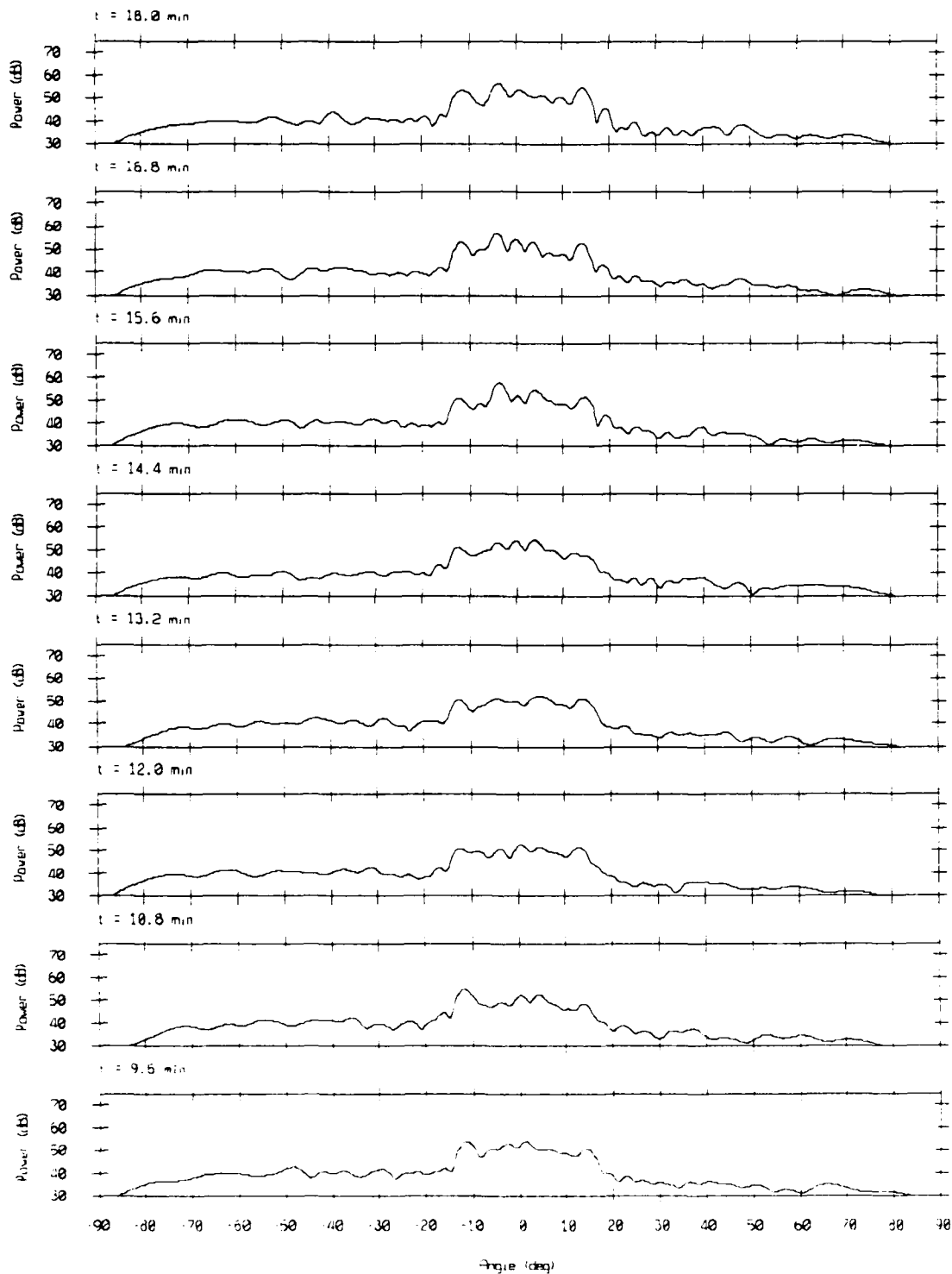
Array Response - 85010 Bin #6393

$f = 254.42$  Hz, rect window



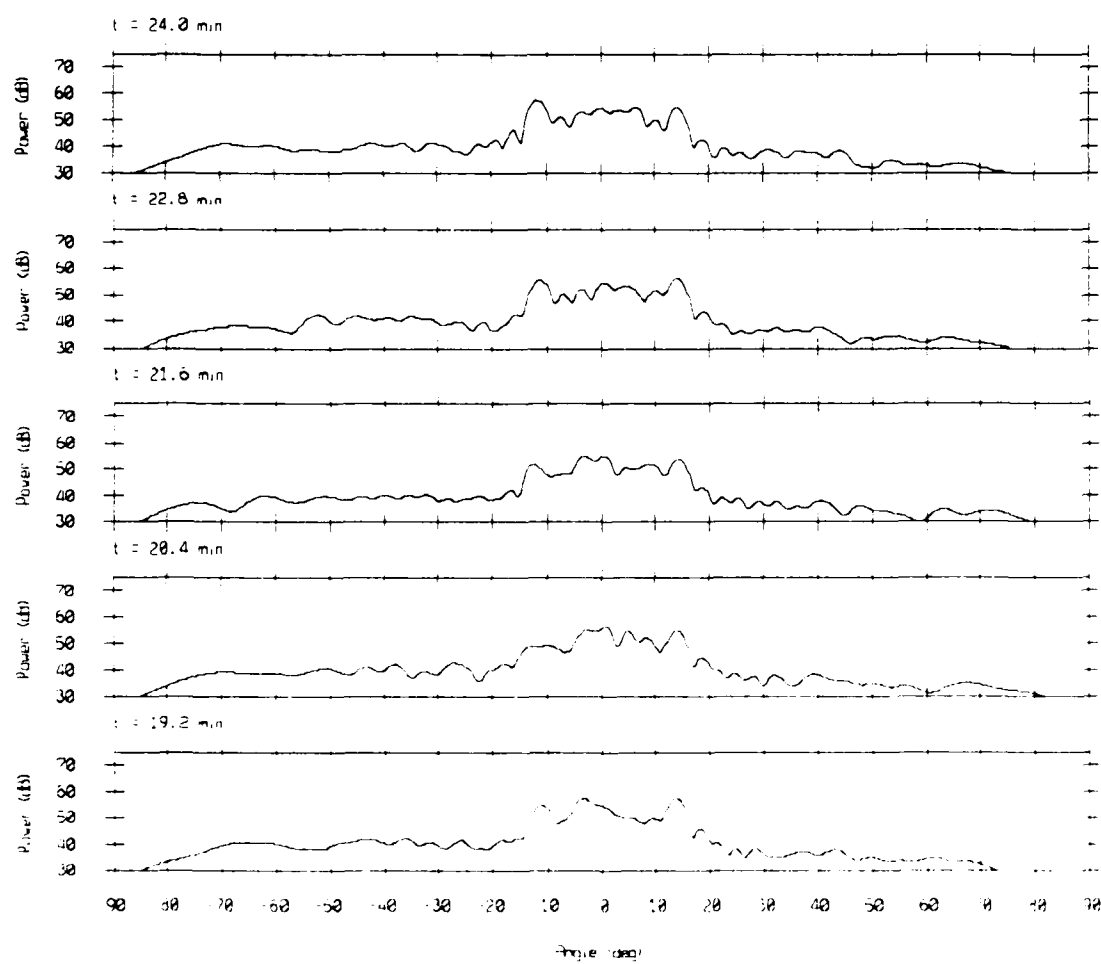
Array Response - 85010 Bin #6393

$f = 254.42$  Hz, rect window



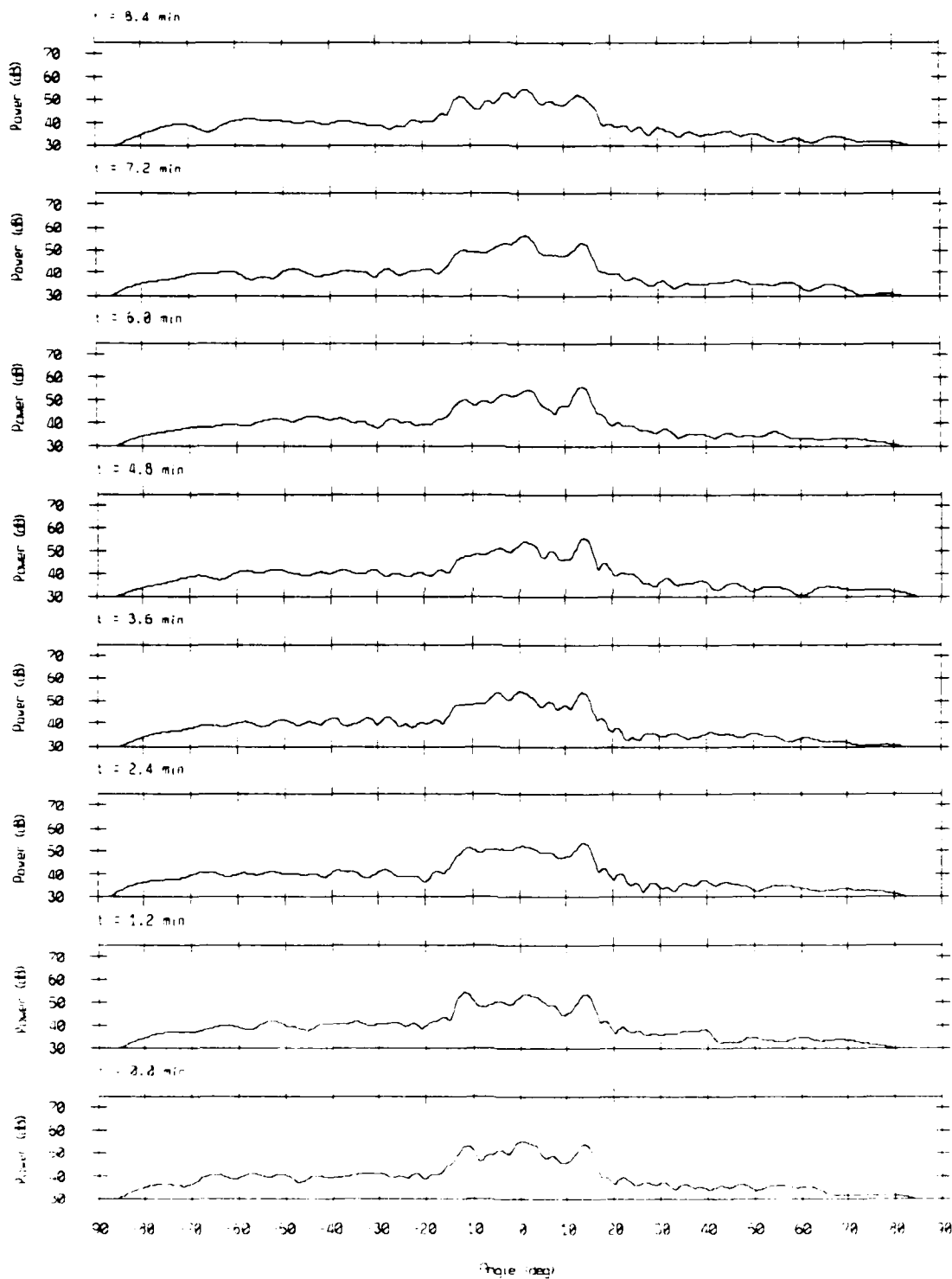
Array Response - 85010 Bin #6393

$f = 254.42$  Hz, rect window



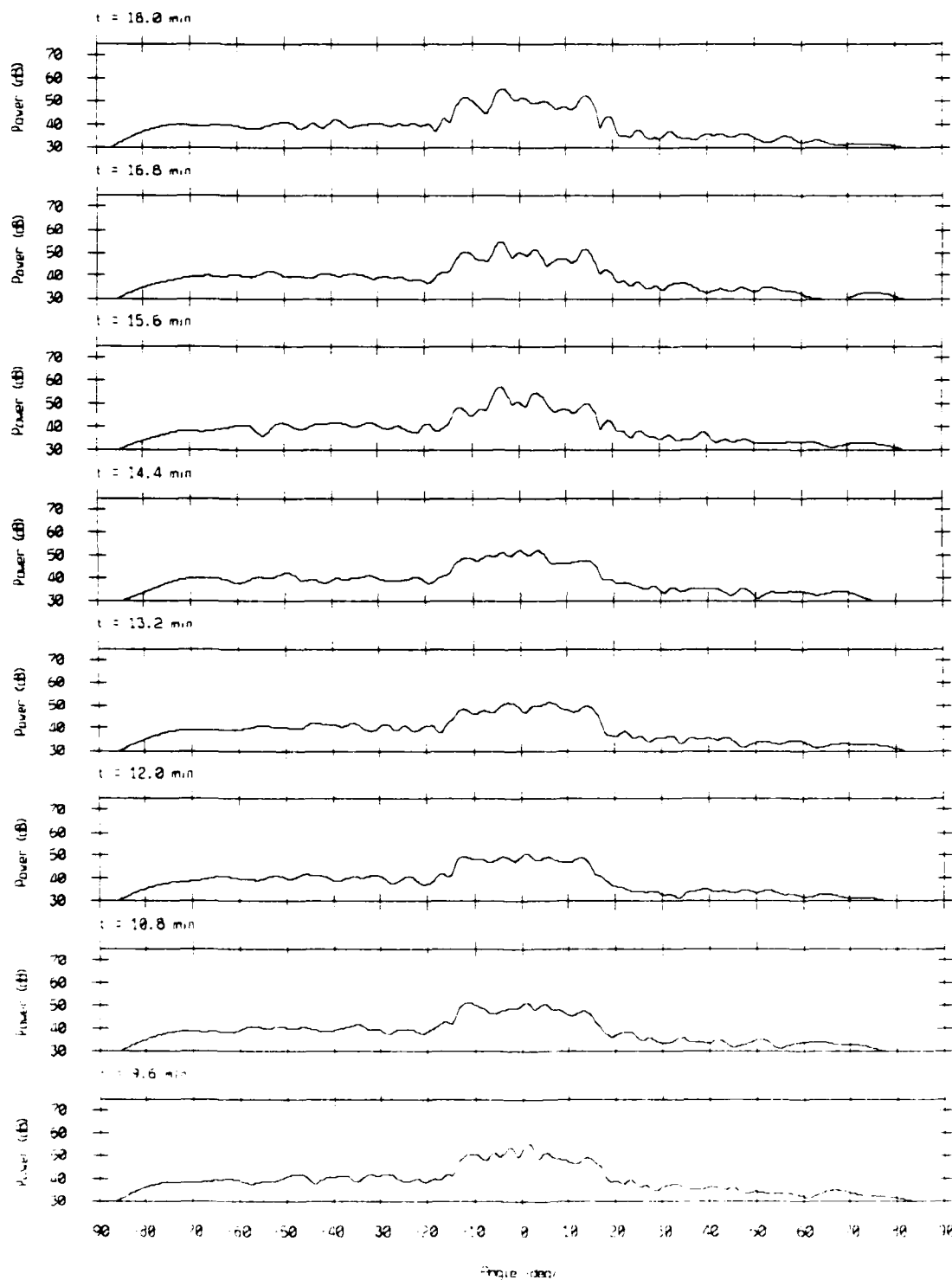
Array Response - 85010 Bin #6394

$f = 254.42$  Hz, rect window



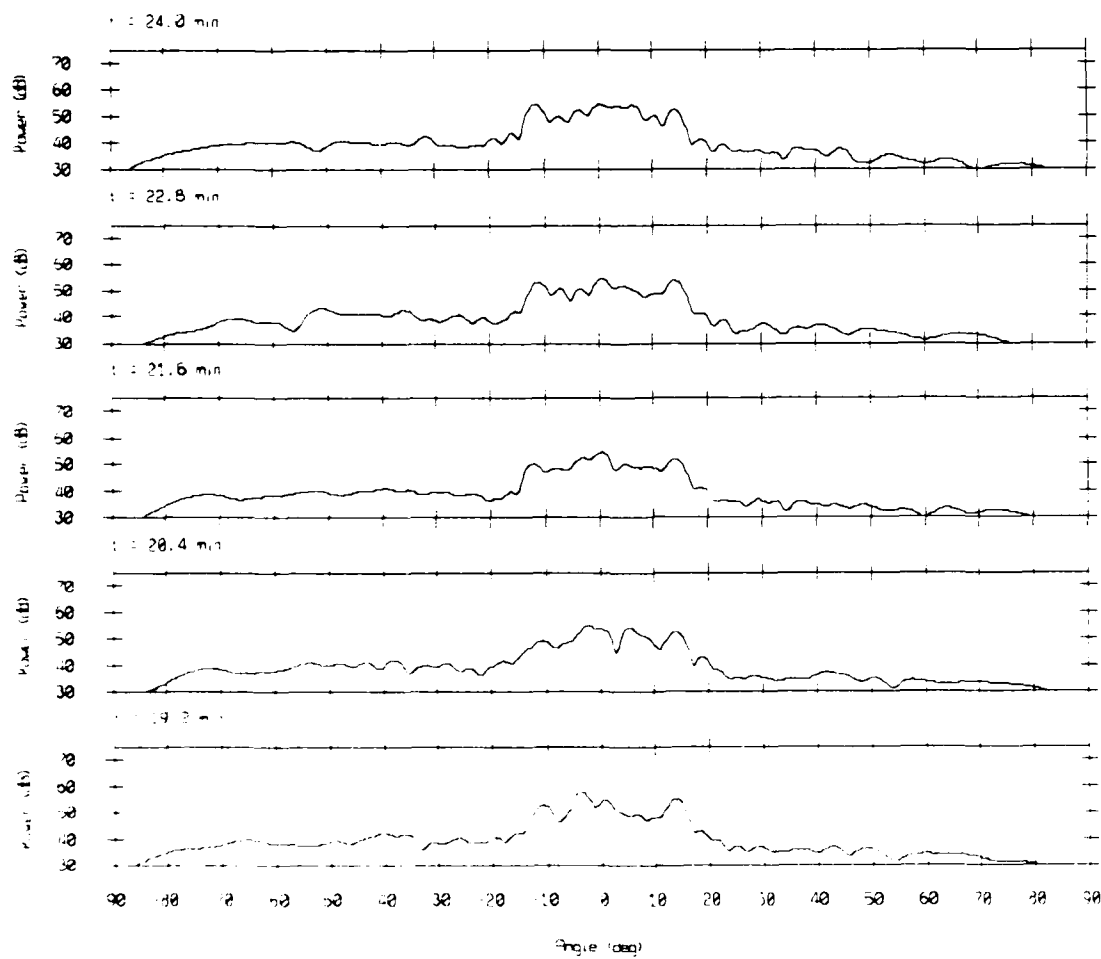
Array Response - 85010 Bin #6394

$f = 254.42$  Hz, rect window



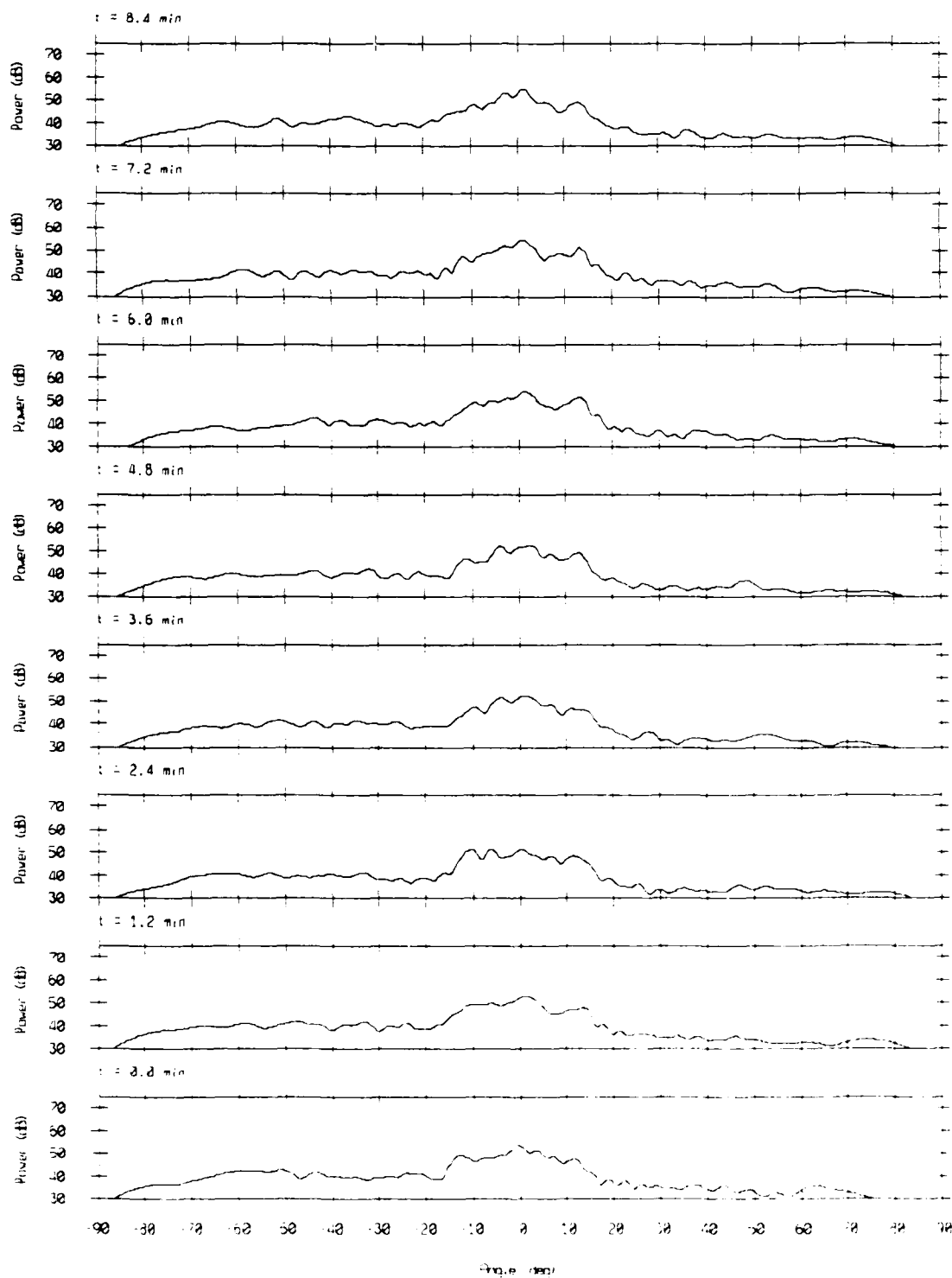
Array Response - 85010 Bin #6394

$f = 254.42$  Hz, rect window



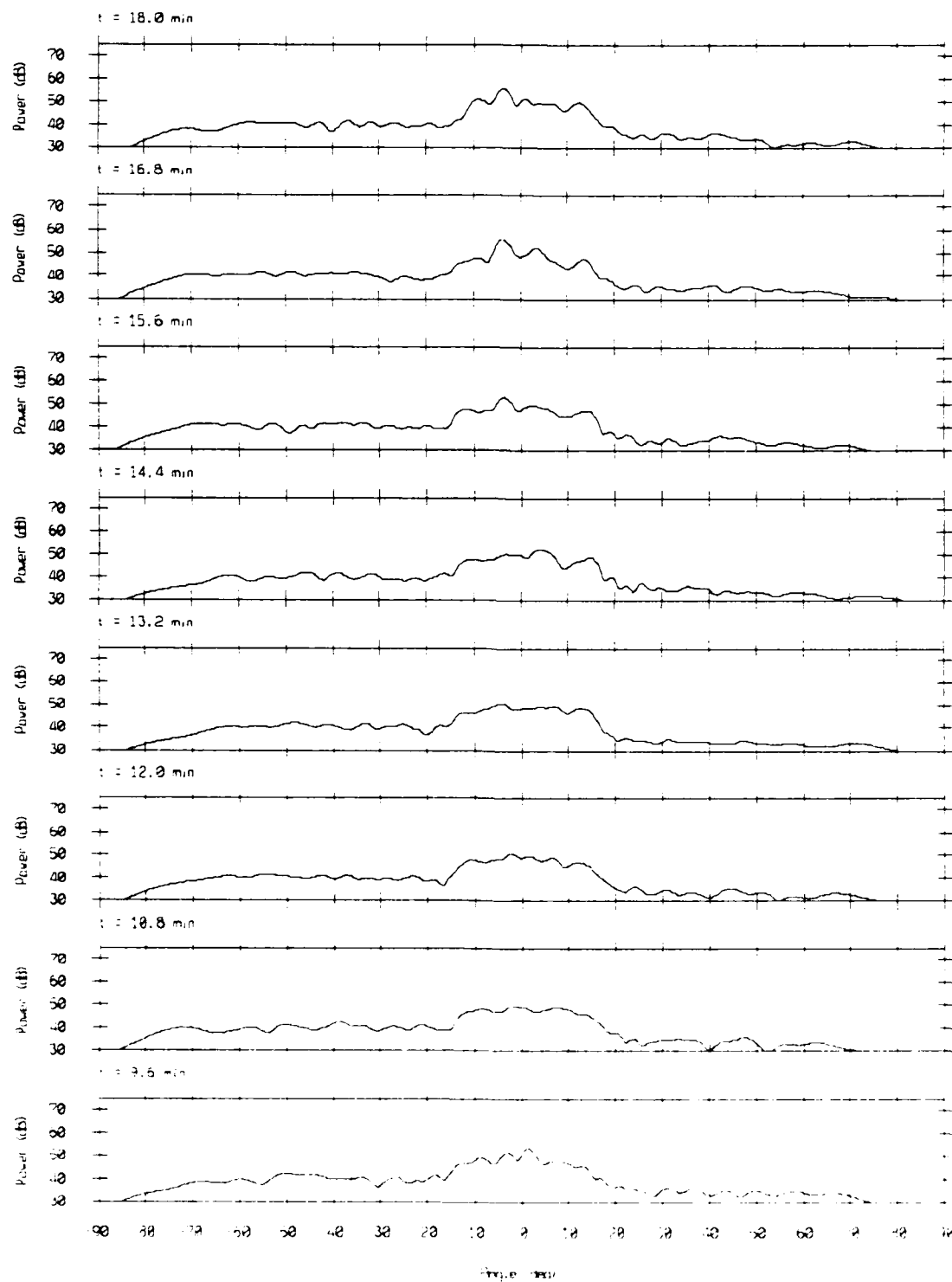
Array Response - 85010 Bin #6399

$f = 255.09$  Hz, rect window



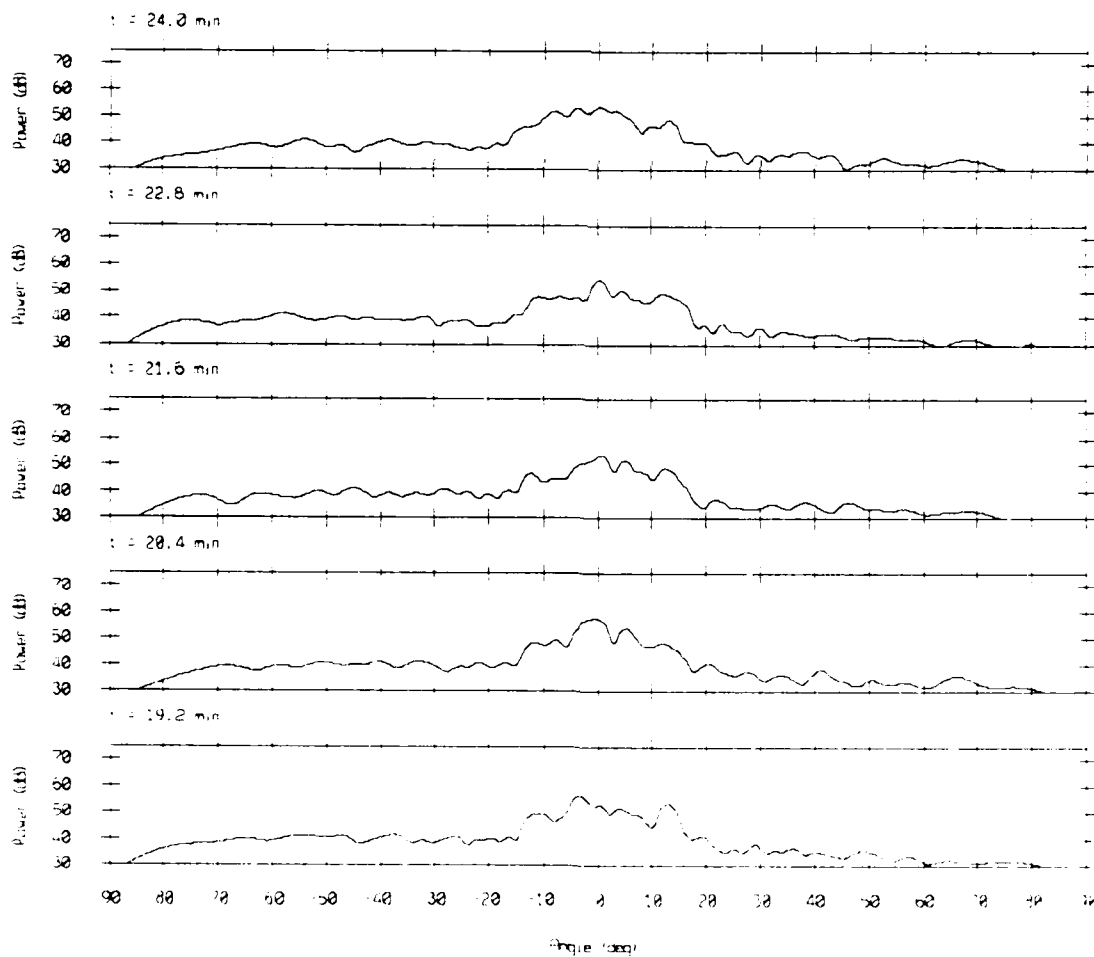
Array Response - 85010 Bin #6399

$f = 255.09$  Hz, rect window



Array Response - 85010 Bin #6399

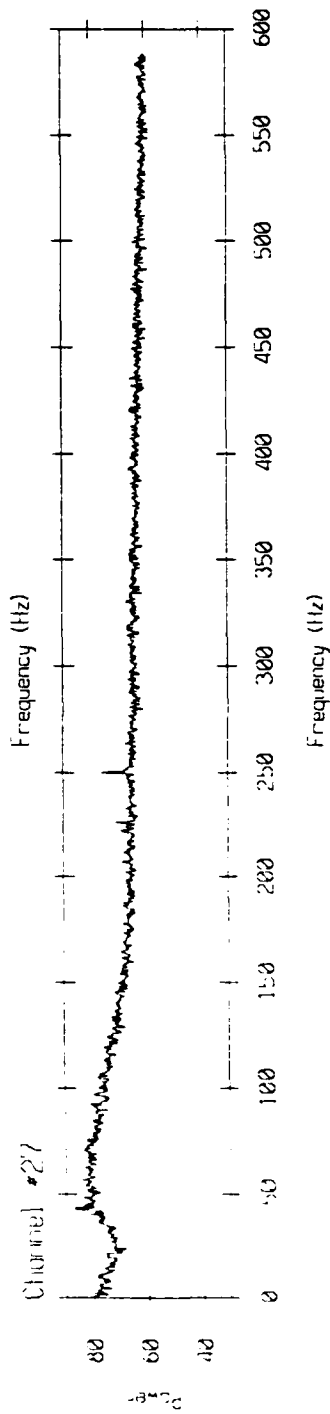
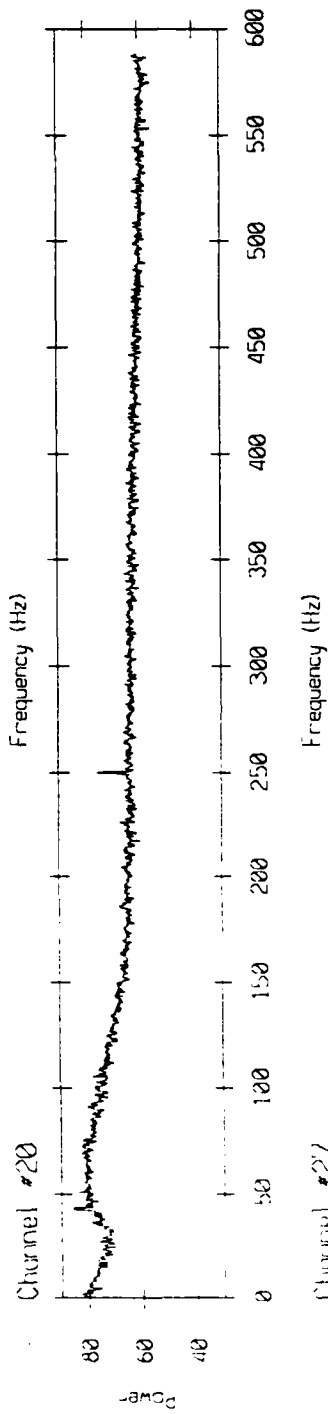
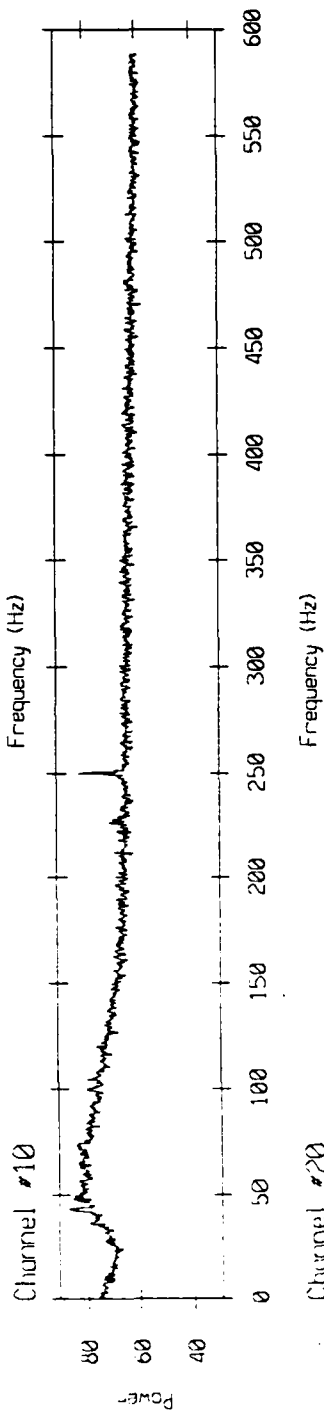
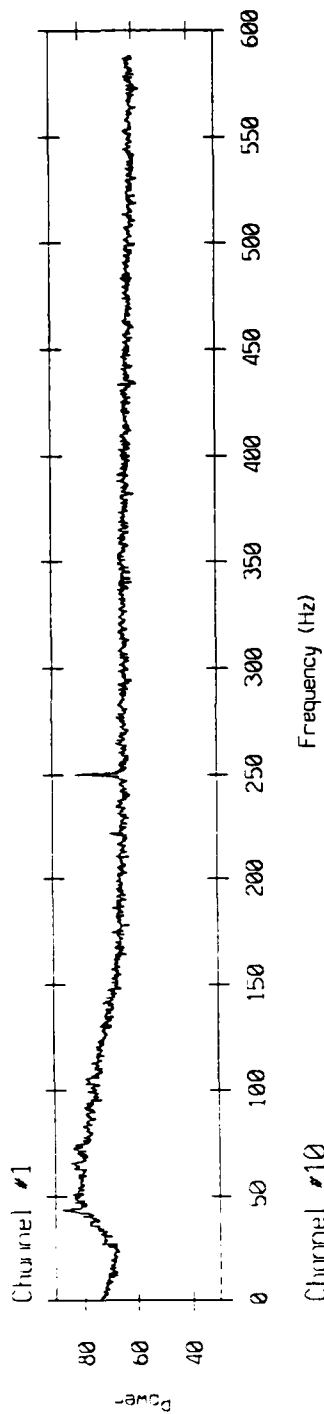
$f = 255.09$  Hz, rect window



V. Tape #86247.

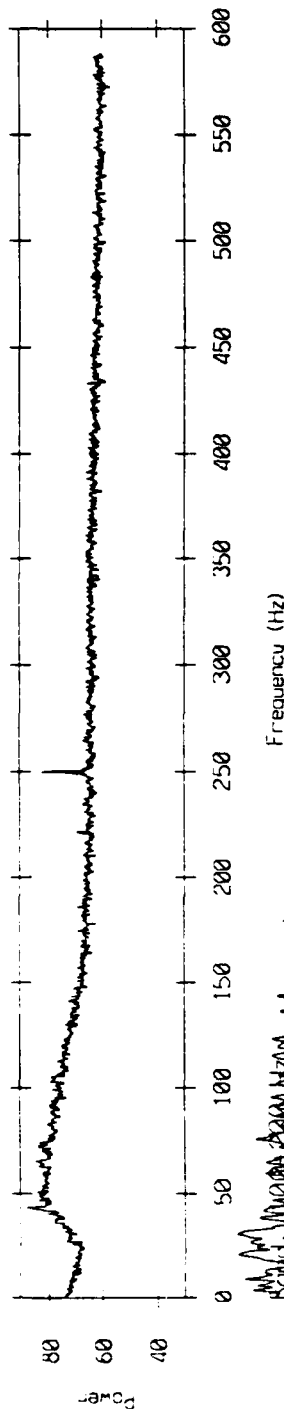
A. Power Spectra.

Power Spectrum - 86247.1

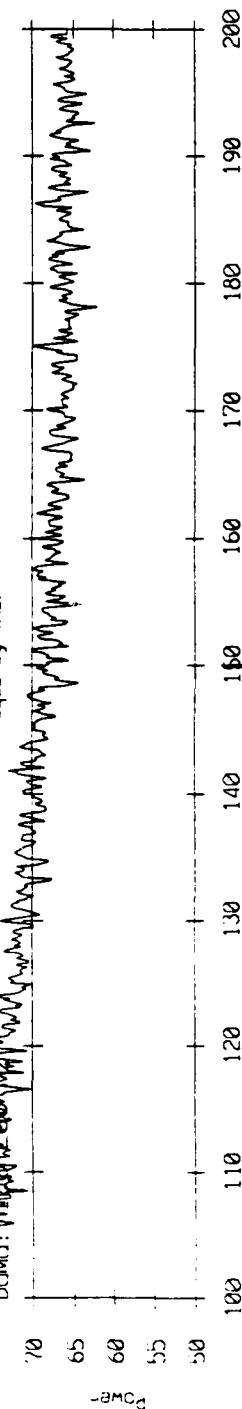


Power Spectrum - 86247.1 Channel #1

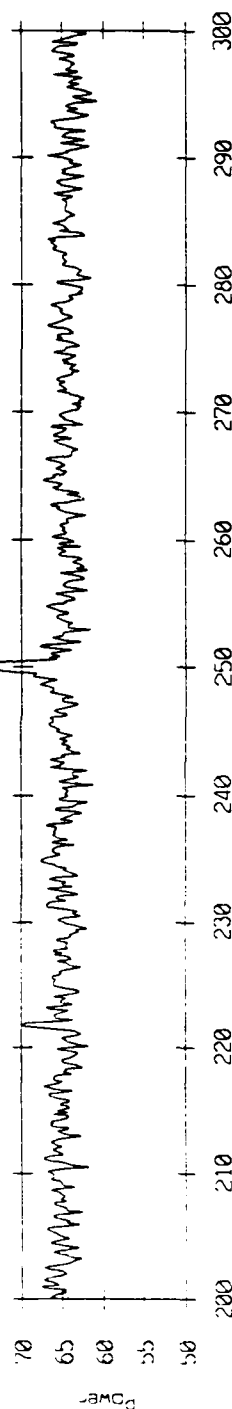
Band: 0-600 Hz



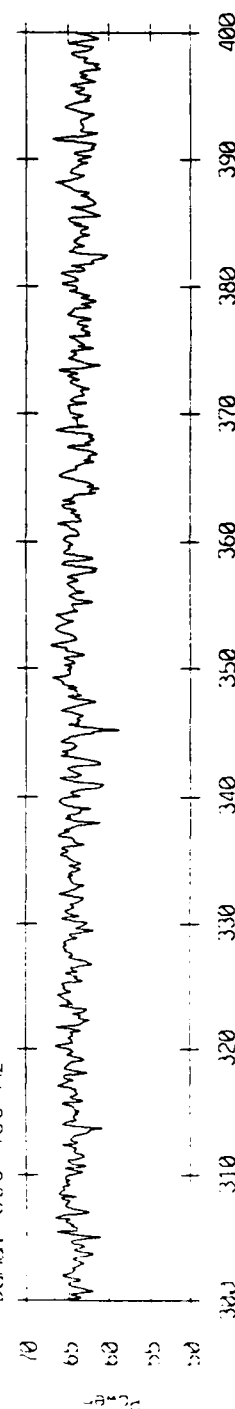
Band: 0-600 Hz



Band: 200-300 Hz

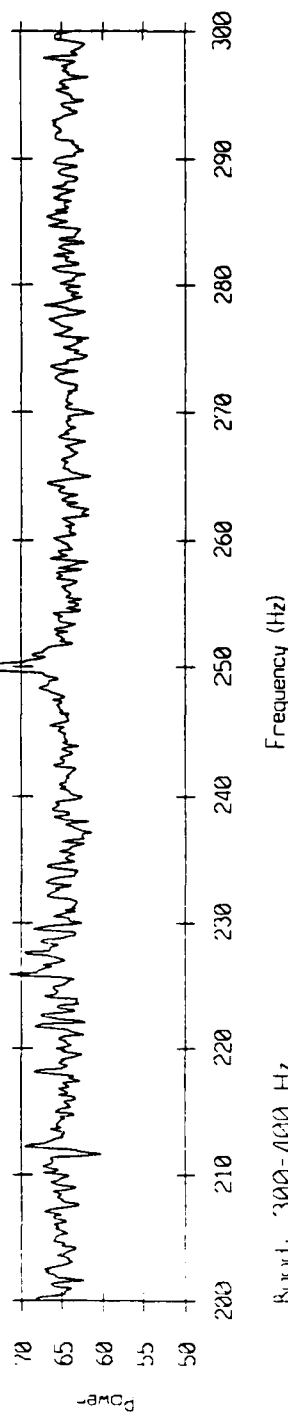
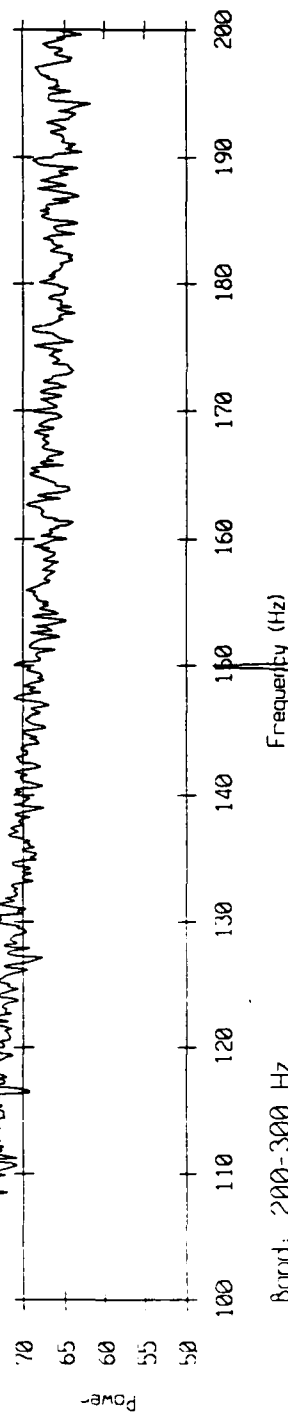
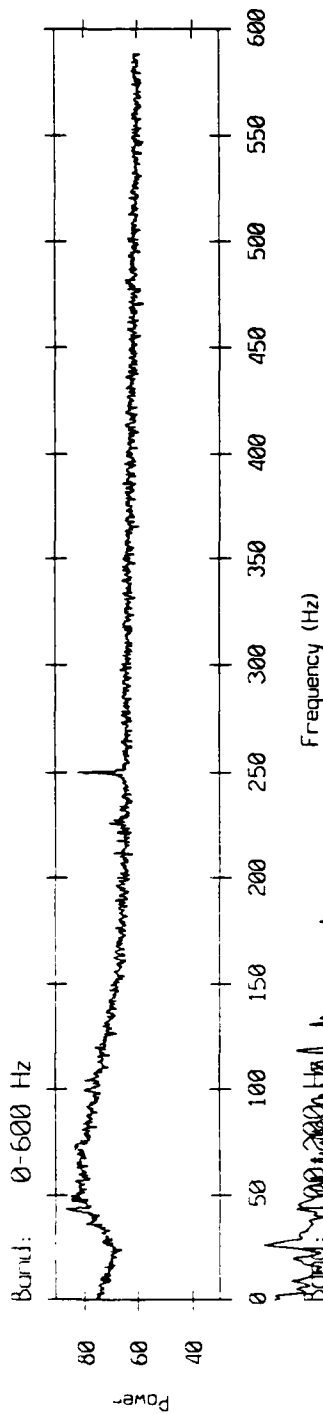


Band: 300-400 Hz



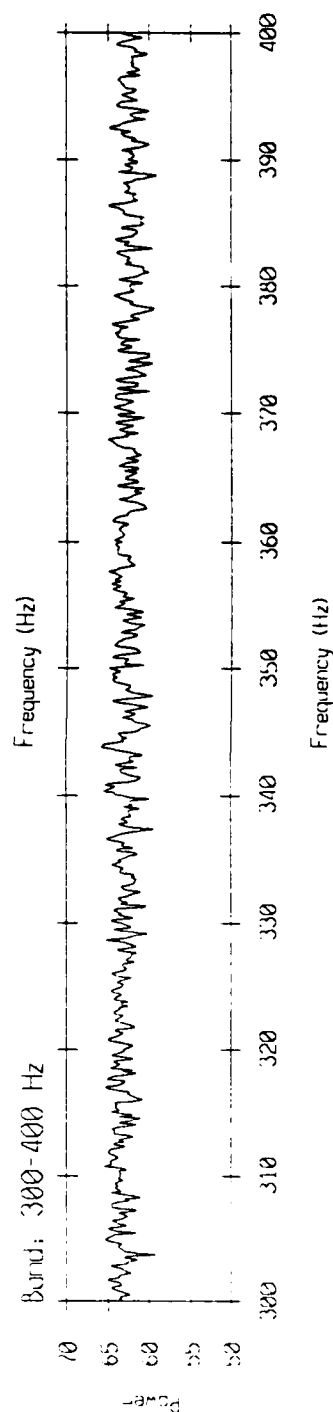
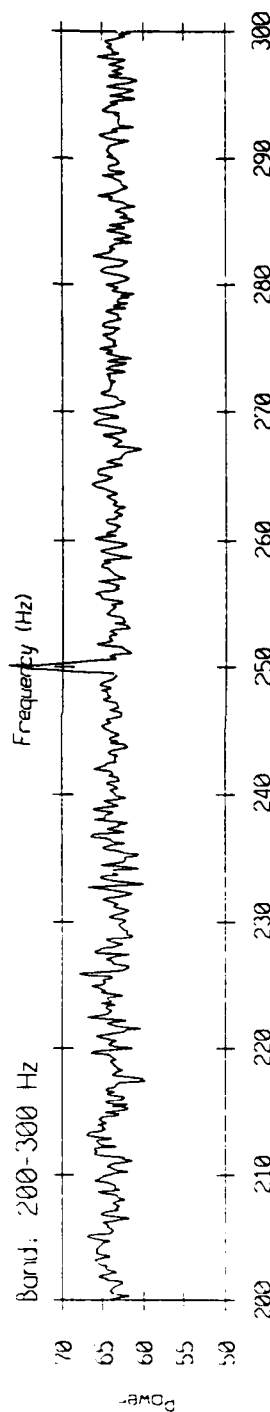
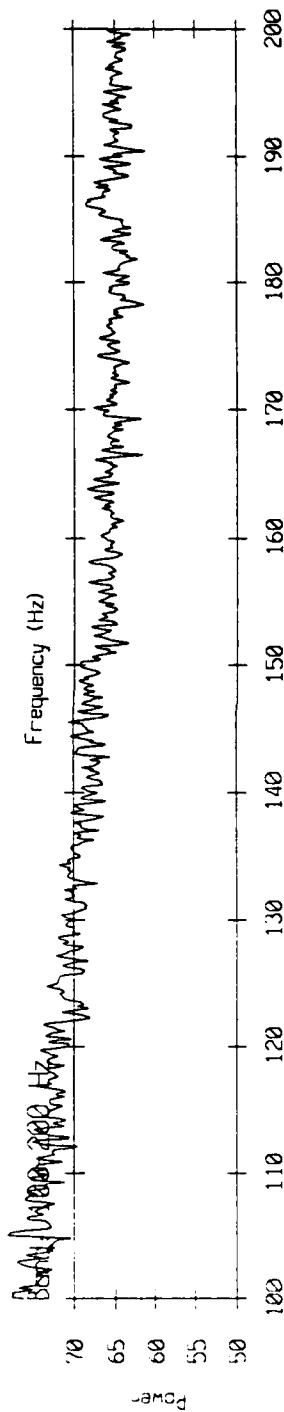
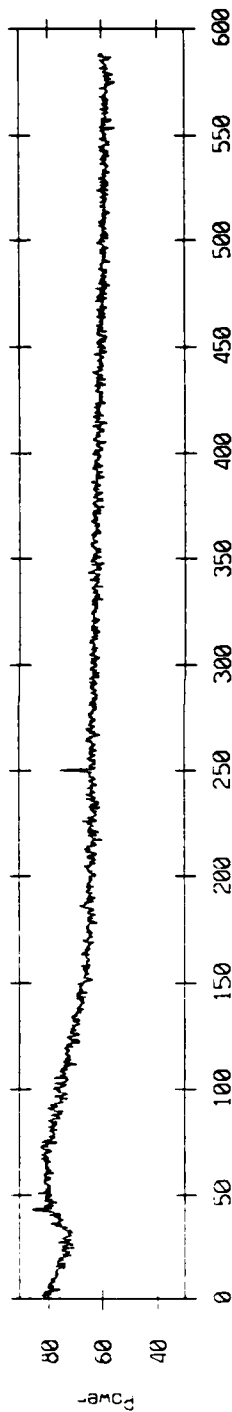
Band: 300-400 Hz

Power Spectrum - 86247.1 Channel #10



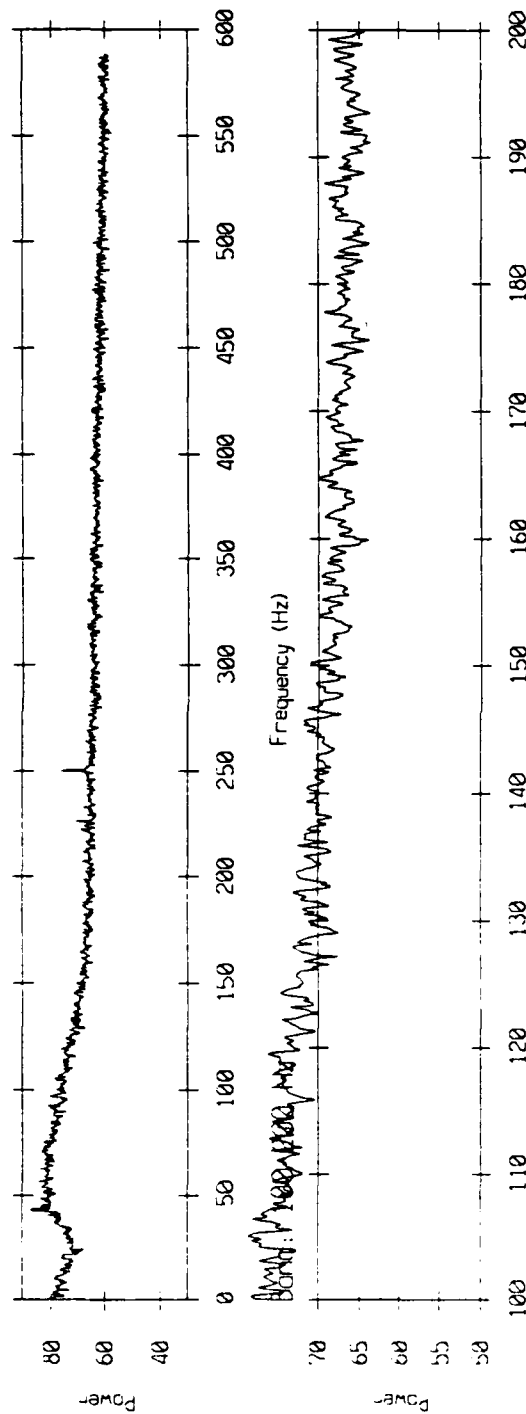
Power Spectrum - 86247.1 Channel #20

Band: 0-600 Hz

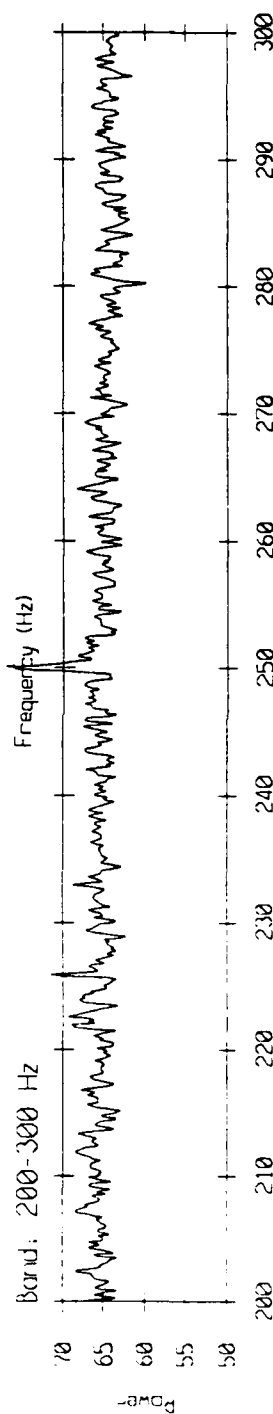


Power Spectrum - 86247.1 Channel #27

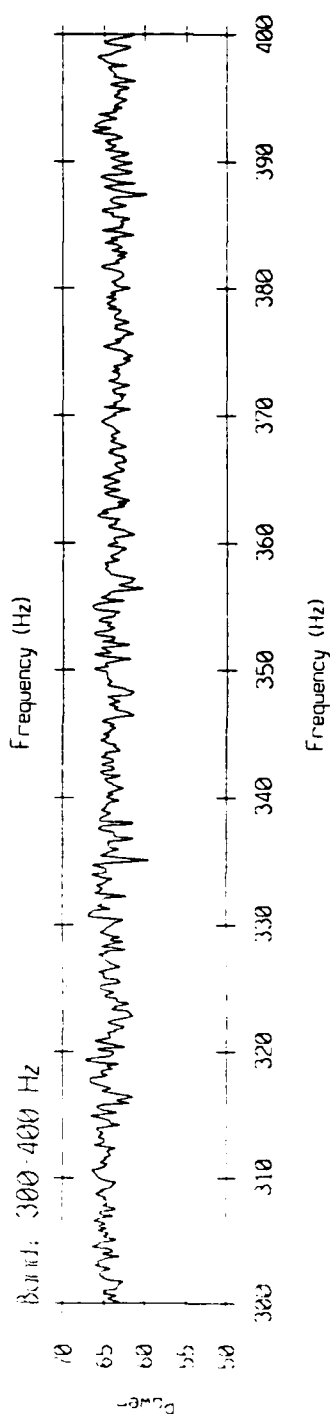
Band: 0-600 Hz



Band: 200-300 Hz



Band: 300-400 Hz



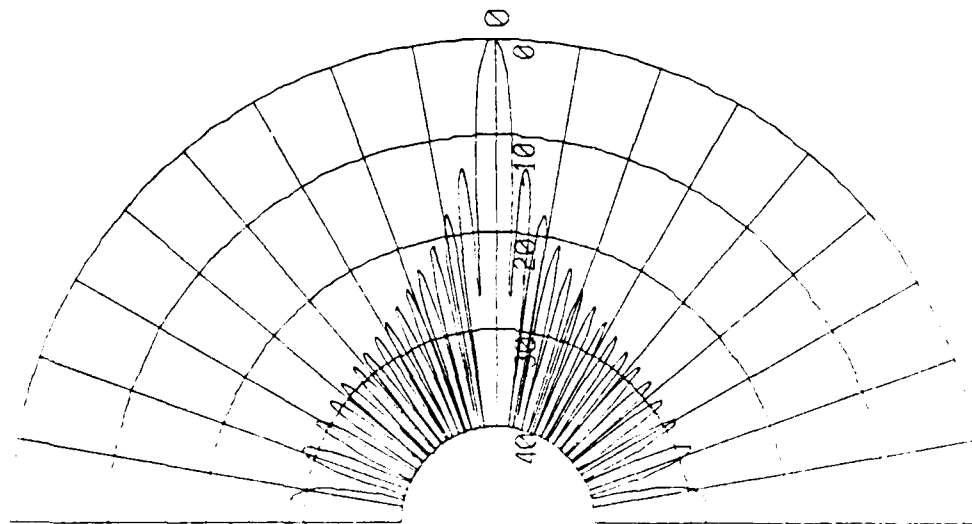
V. Tape #86247.

B. Beam Patterns (250 Hz).

# M14 Array Beam Pattern:

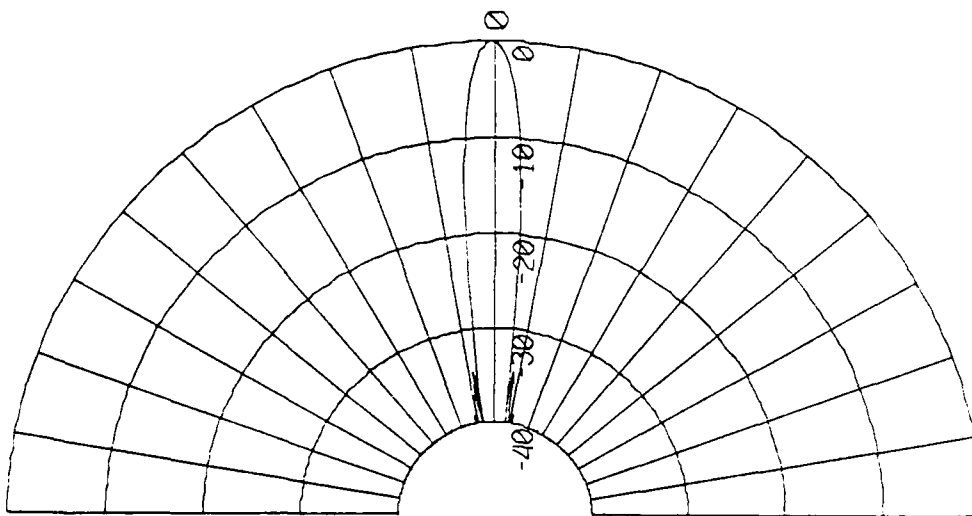
f = 2.50, rect window (left), KB window ( $\alpha = 1.5$ ) (right)

(a)

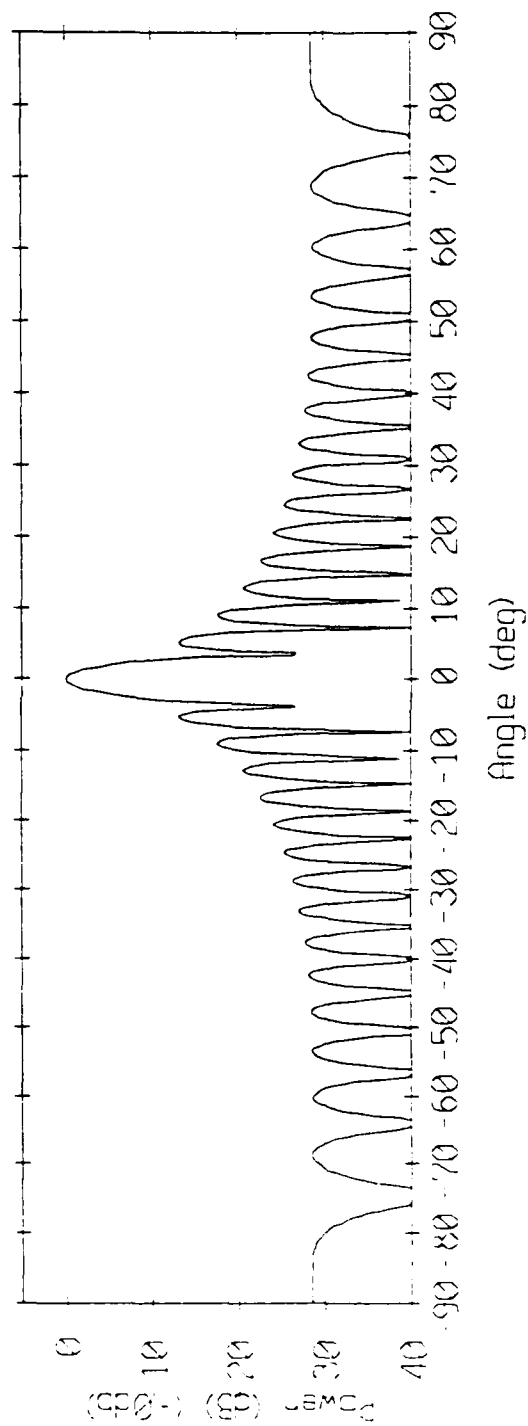
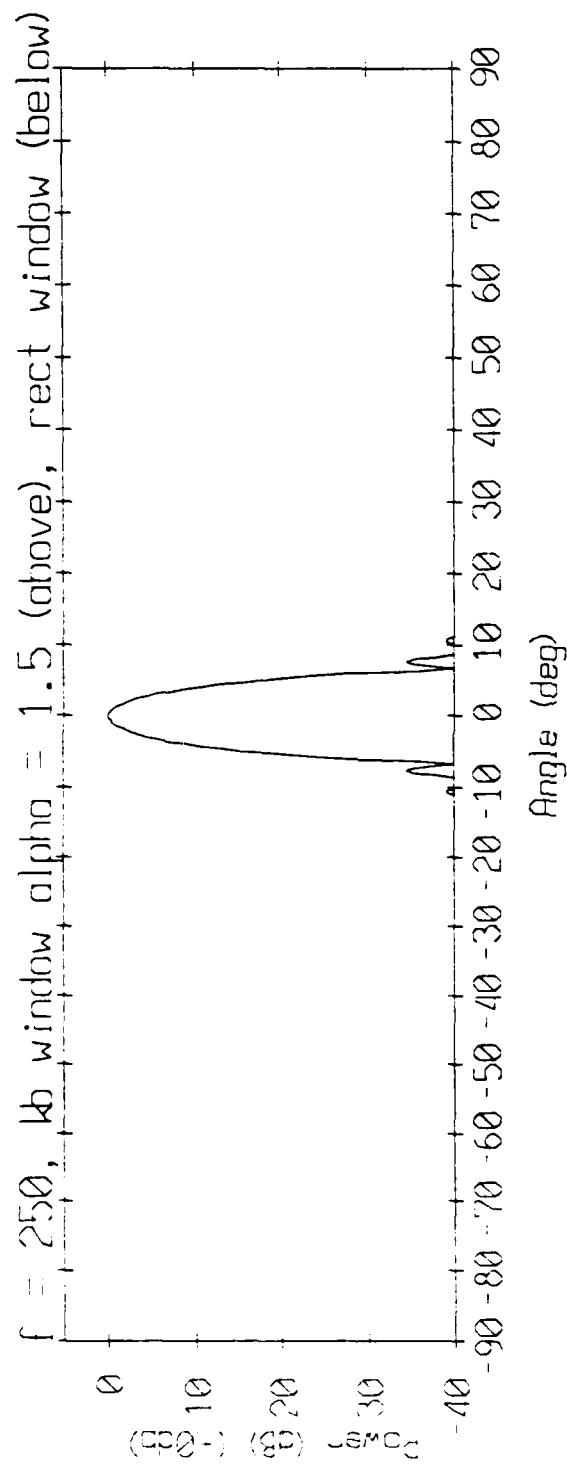


(b)

(c)



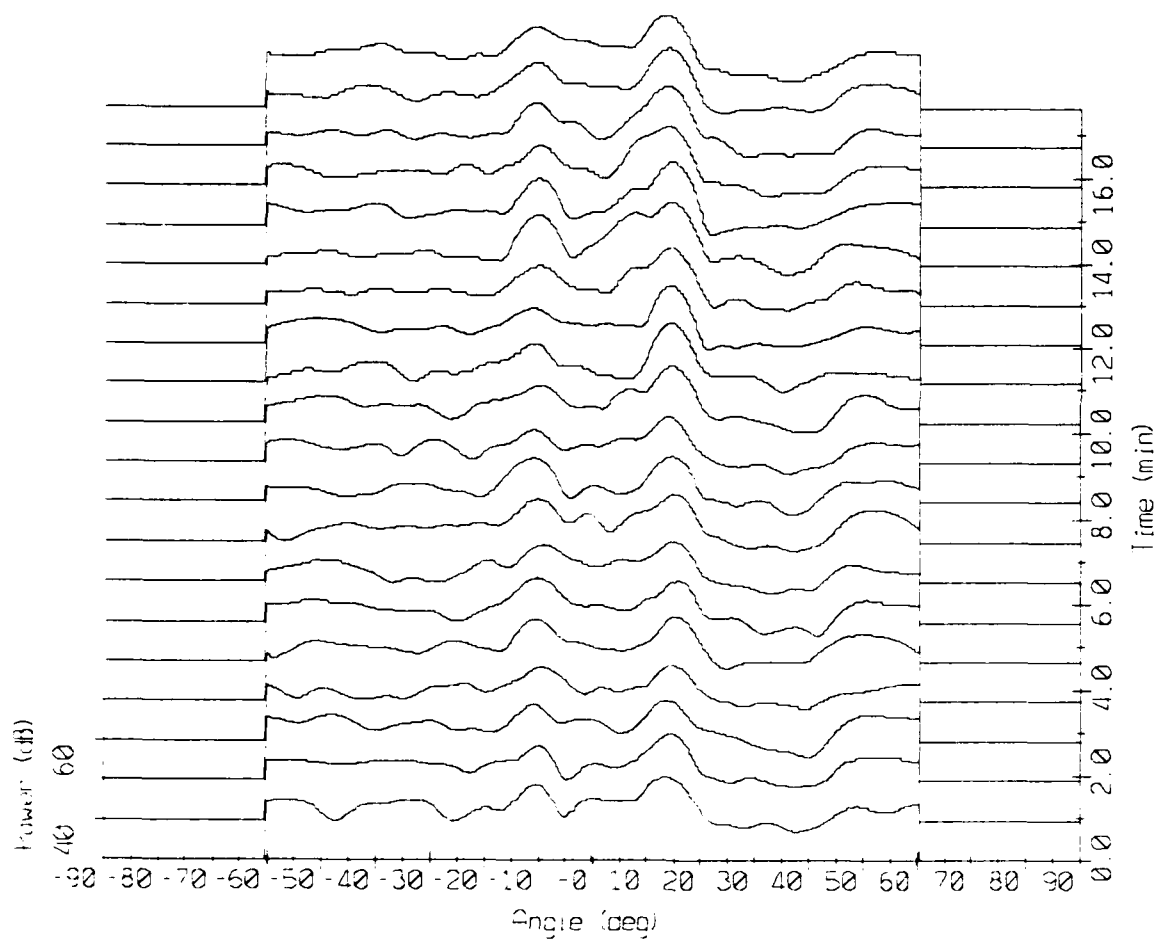
(d)



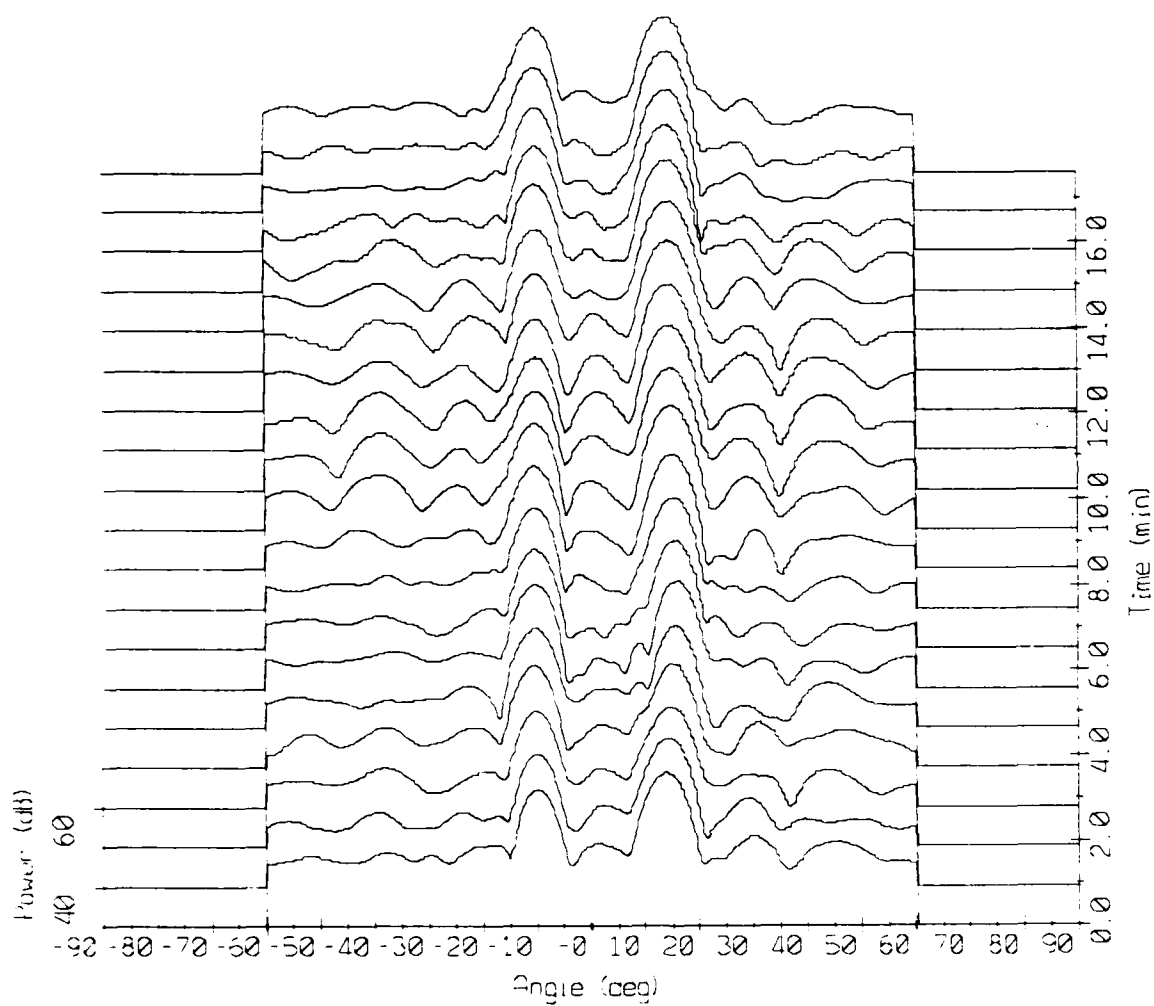
V. Tape #86247.

C. Array Response: Waterfall, KB Window.

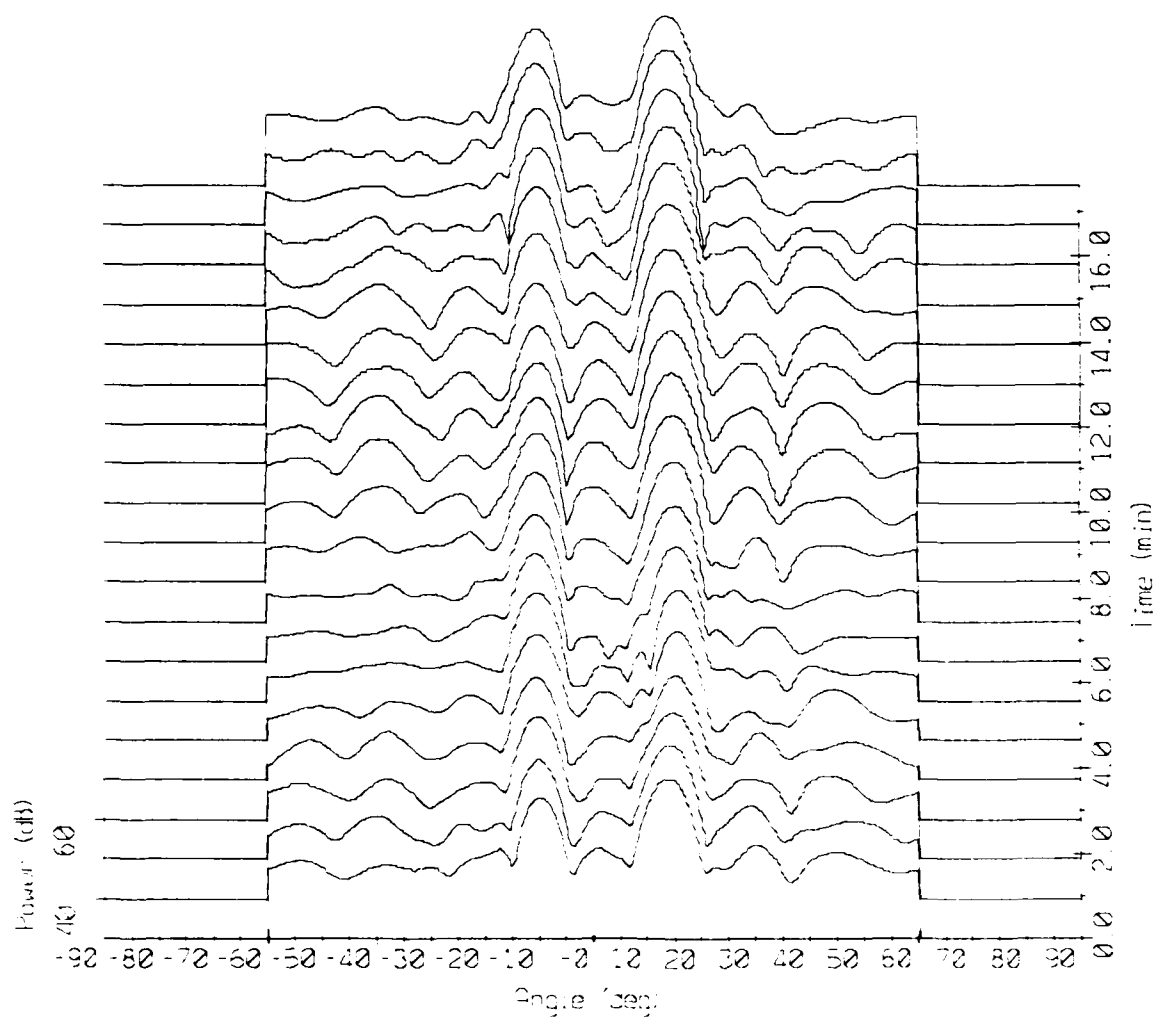
Array Response - 86247 Bin #5832  
 $f = 249.17$  Hz, KB window ( $\alpha = 1.5$ )



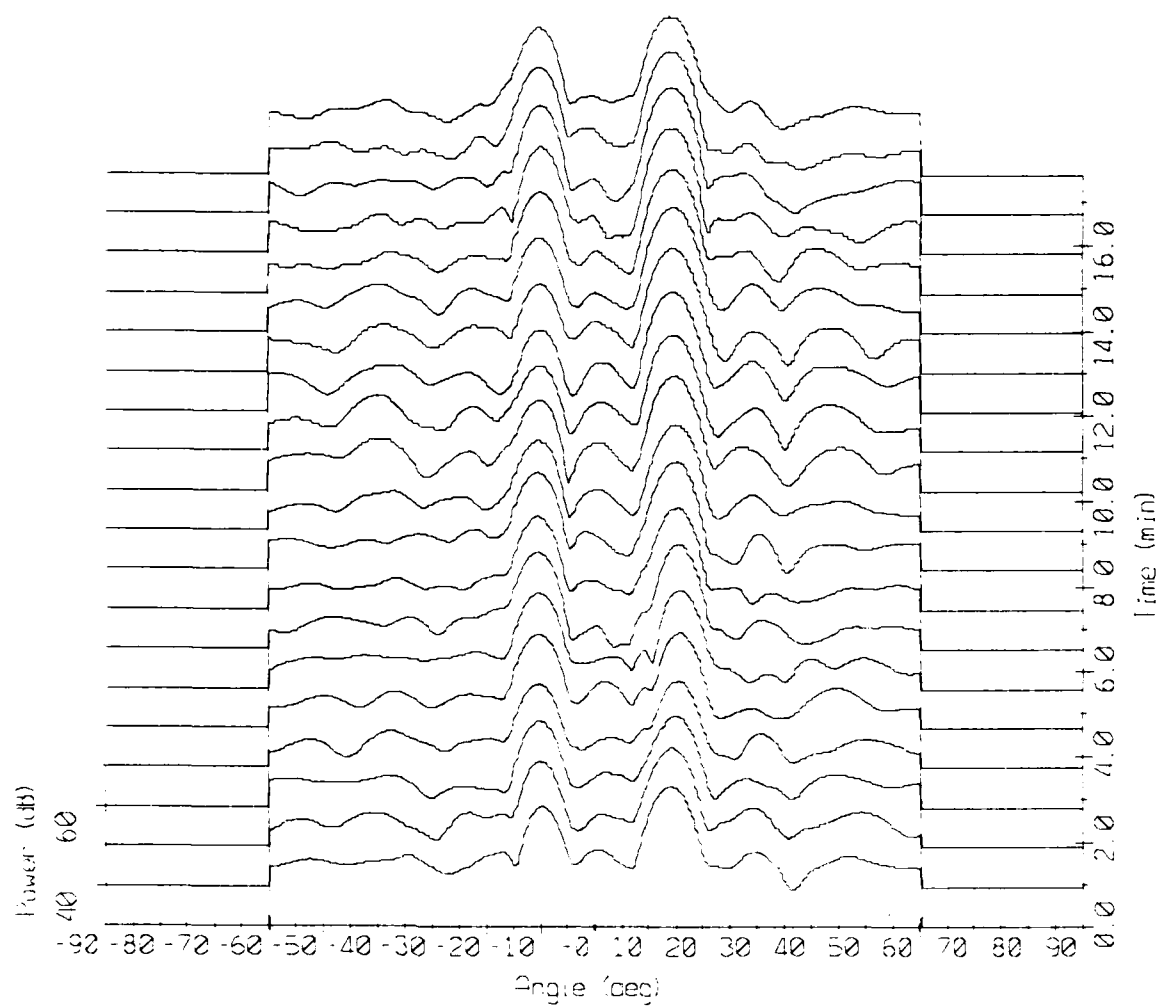
Array Response - 86247 Bin #5837  
 $f = 249.88$  Hz, KB window ( $\alpha = 1.5$ )



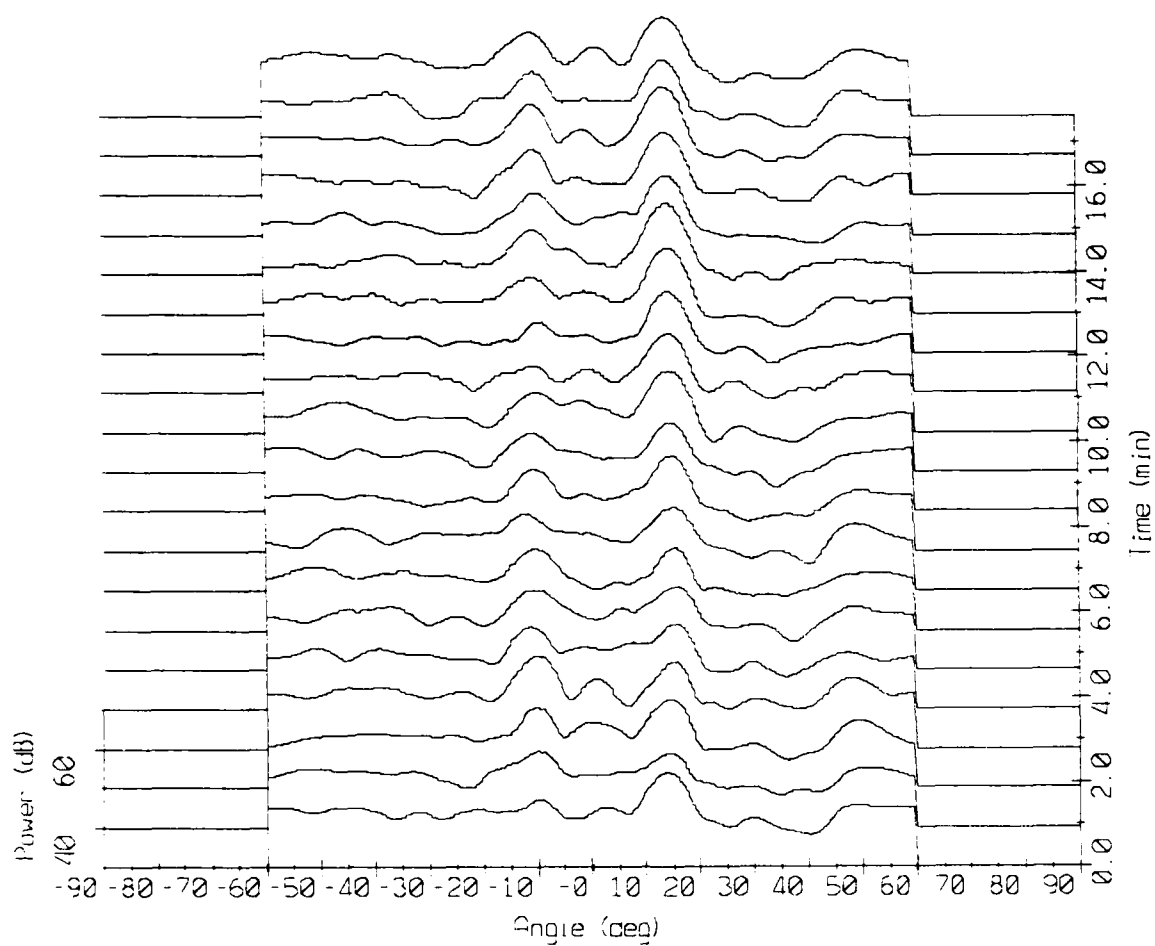
Array Response - 86247 Bin #5838  
 $f = 250$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 86247 Bin #5839  
 $f = 250.17$  Hz, KB window (alpha = 1.5)



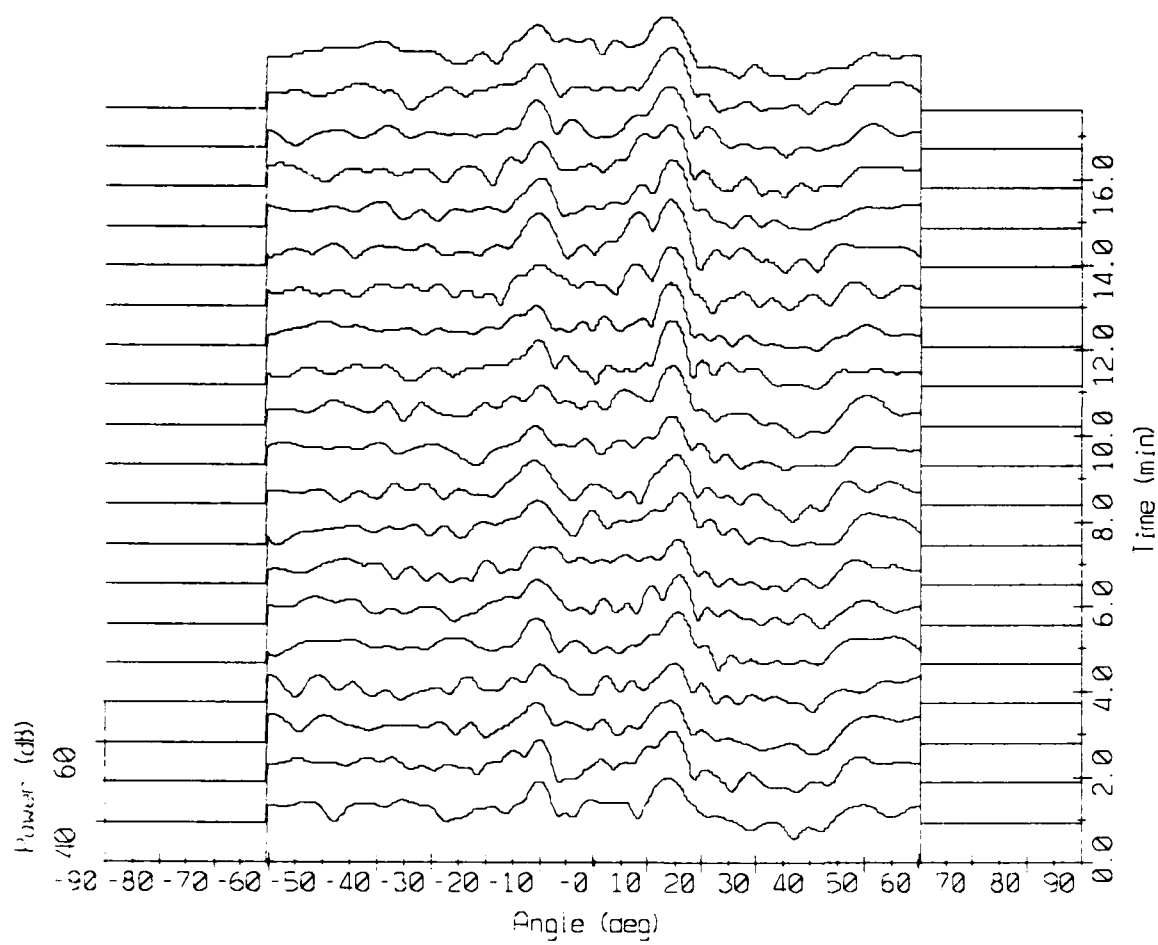
Array Response - 86247 Bin #5844  
 $f = 250.89$  Hz, KB window ( $\alpha = 1.5$ )



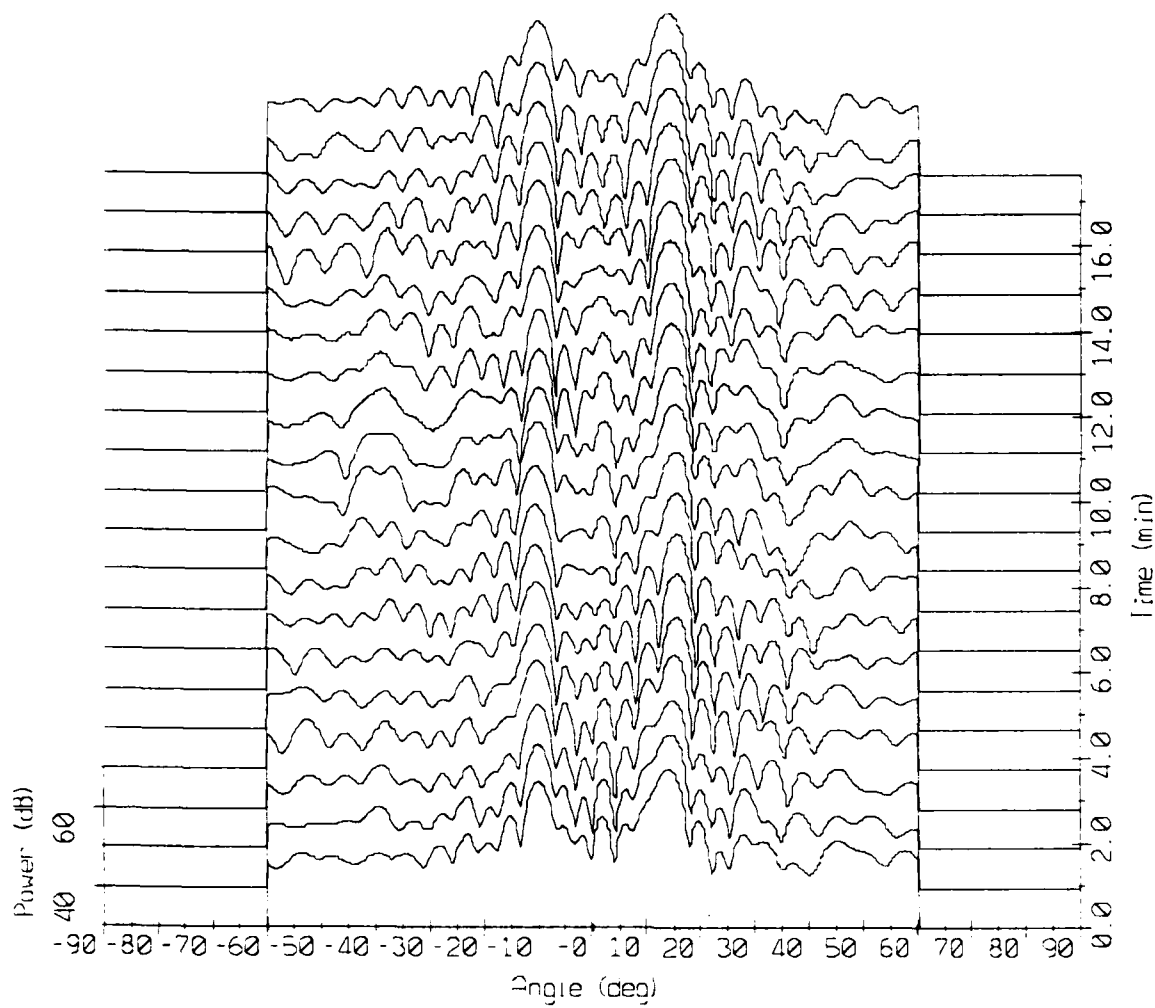
V. Tape #86247.

D. Array Response: Waterfall, Rect Window.

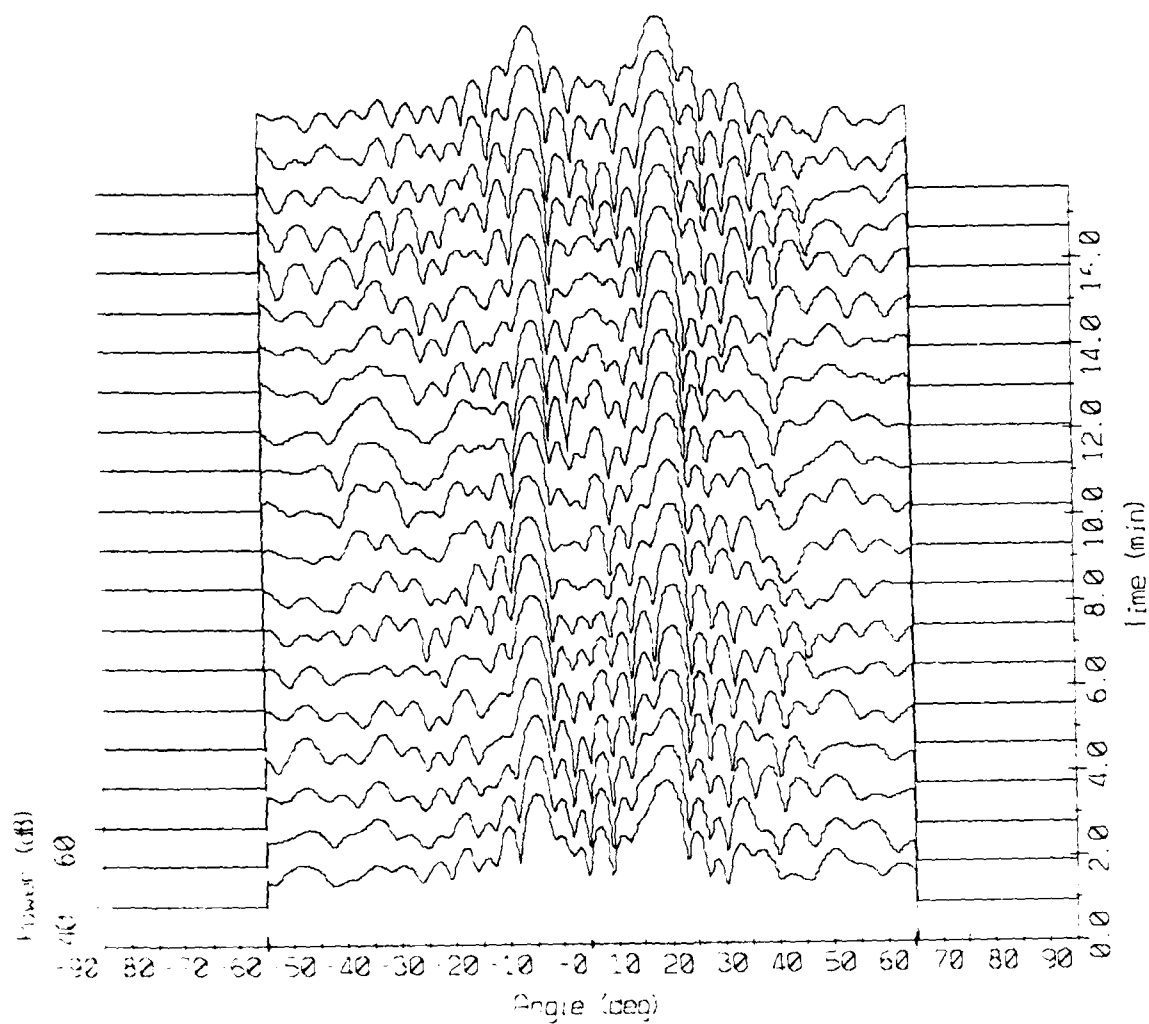
Array Response - 86247 Bin #5832  
 $f = 249.17$  Hz, rect window



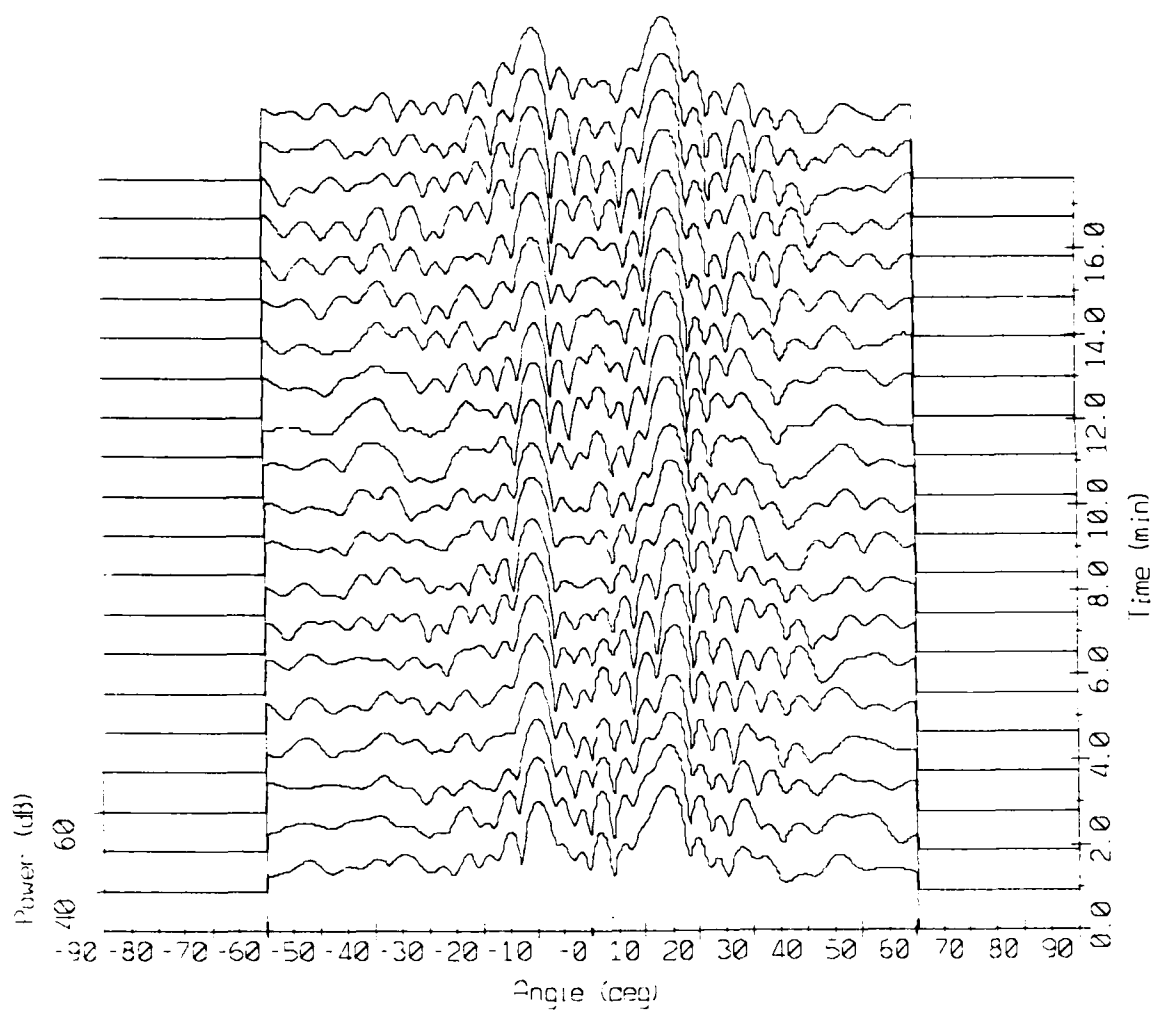
Array Response - 86247 Bin #5837  
 $f = 249.88$  Hz, rect window



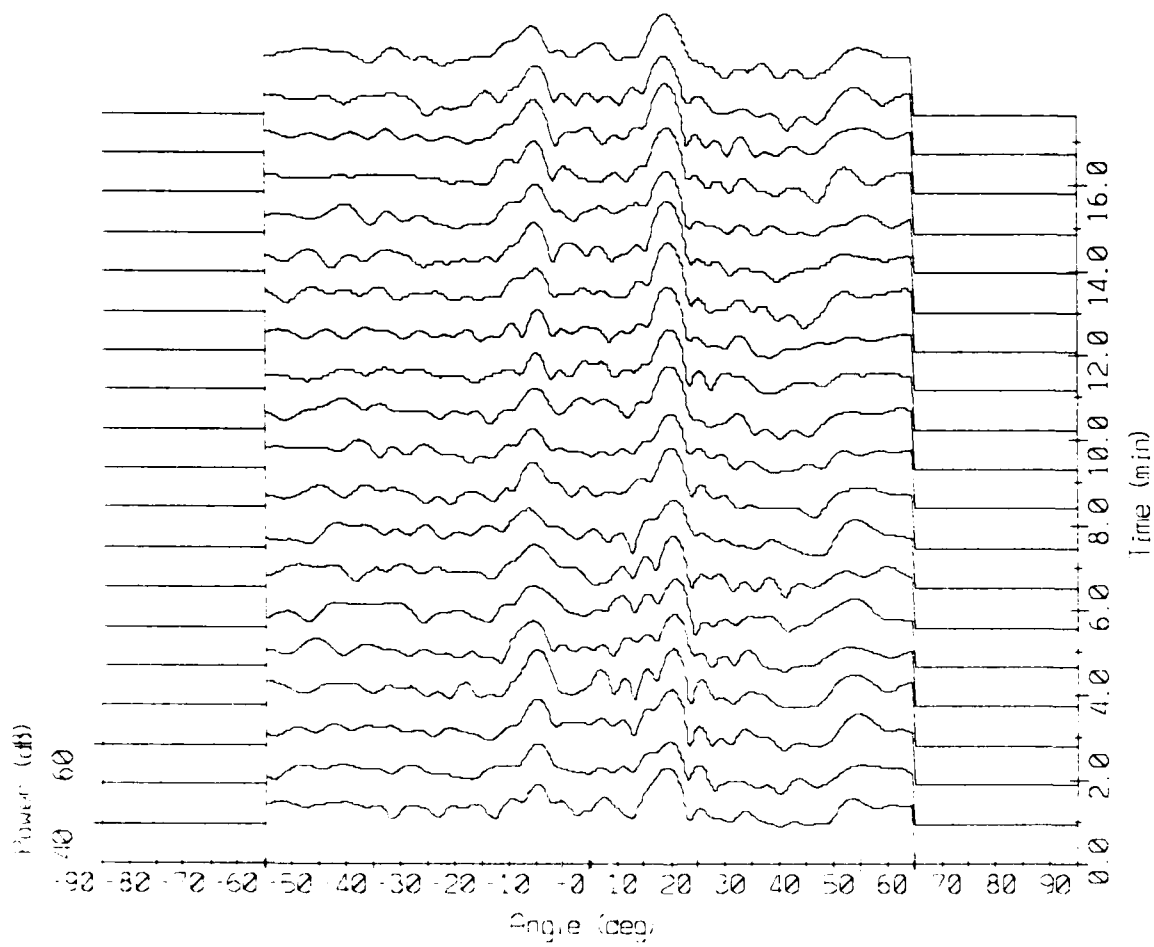
Array Response - 86247 Bin #5838  
 $f = 250$  Hz, rect window



Array Response - 86247 Bin #5839  
 $f = 250.17$  Hz, rect window



Array Response - 86247 Bin #5844  
 $f = 250.89$  Hz, rect window

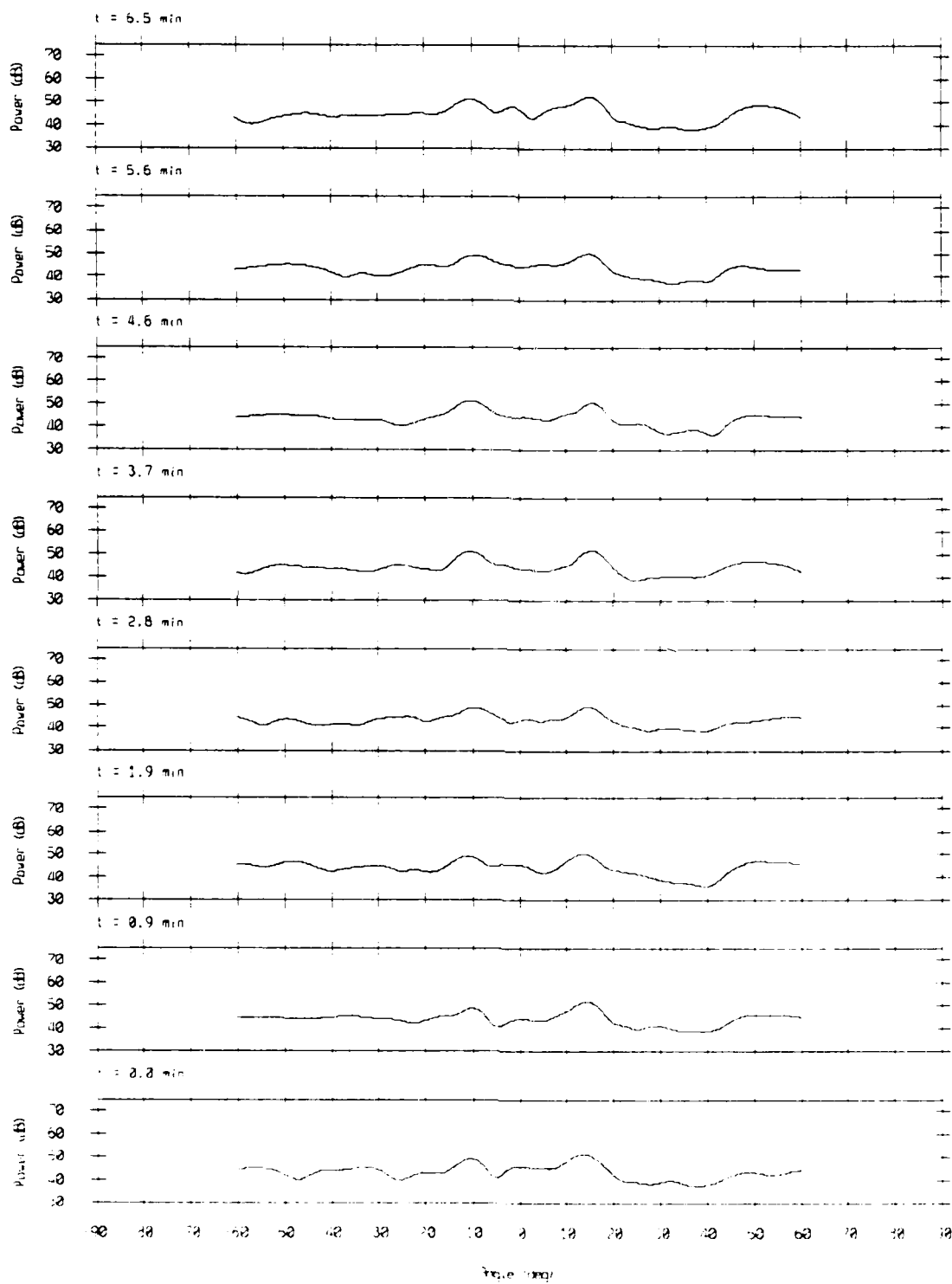


V. Tape #86247.

E. Array Response: Panels, KB Window.

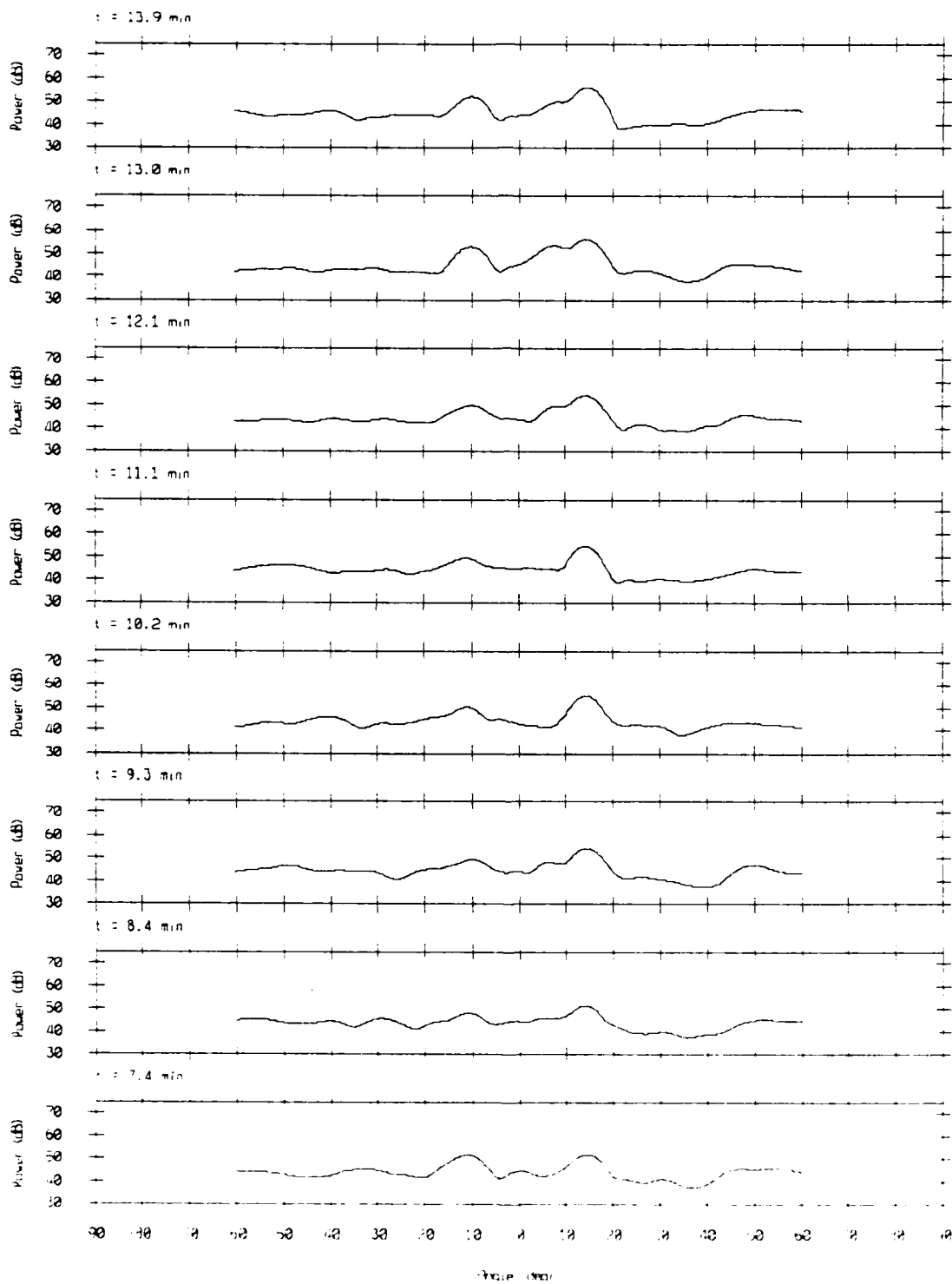
Array Response - 86247 Bin #5832

$f = 249.17$  Hz, KB window ( $\alpha = 1.5$ )



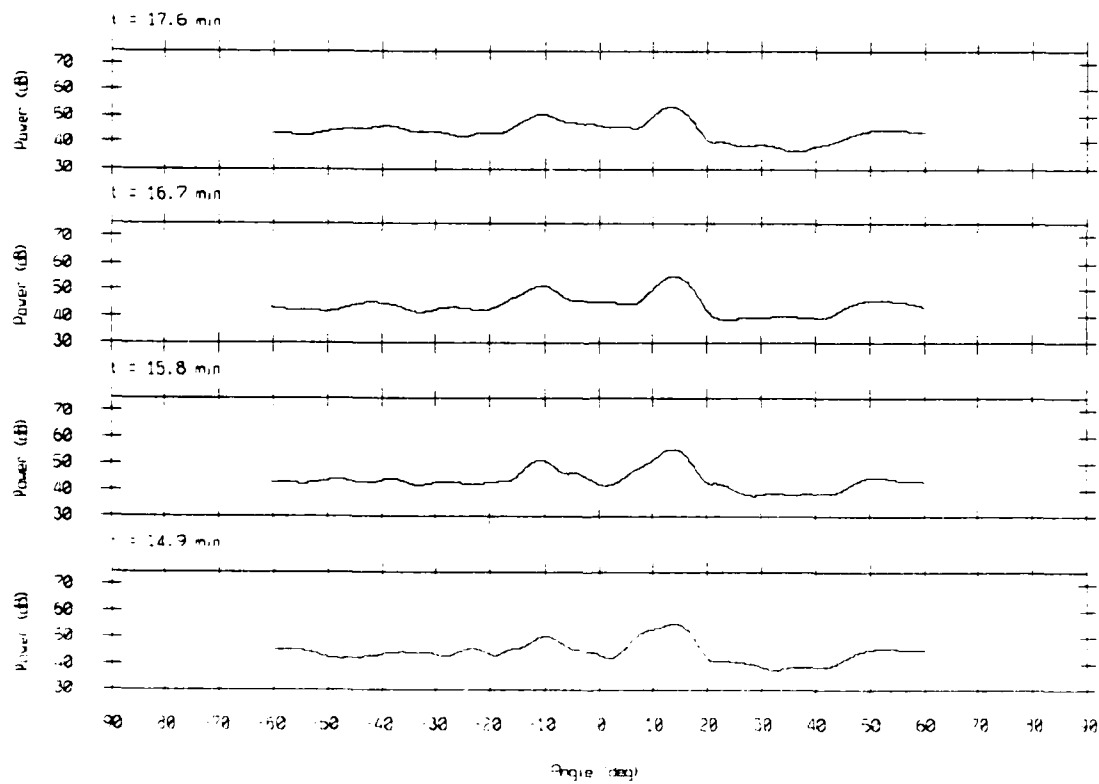
# Array Response - 86247 Bin #5832

$f = 249.17$  Hz, KB window ( $\alpha = 1.5$ )



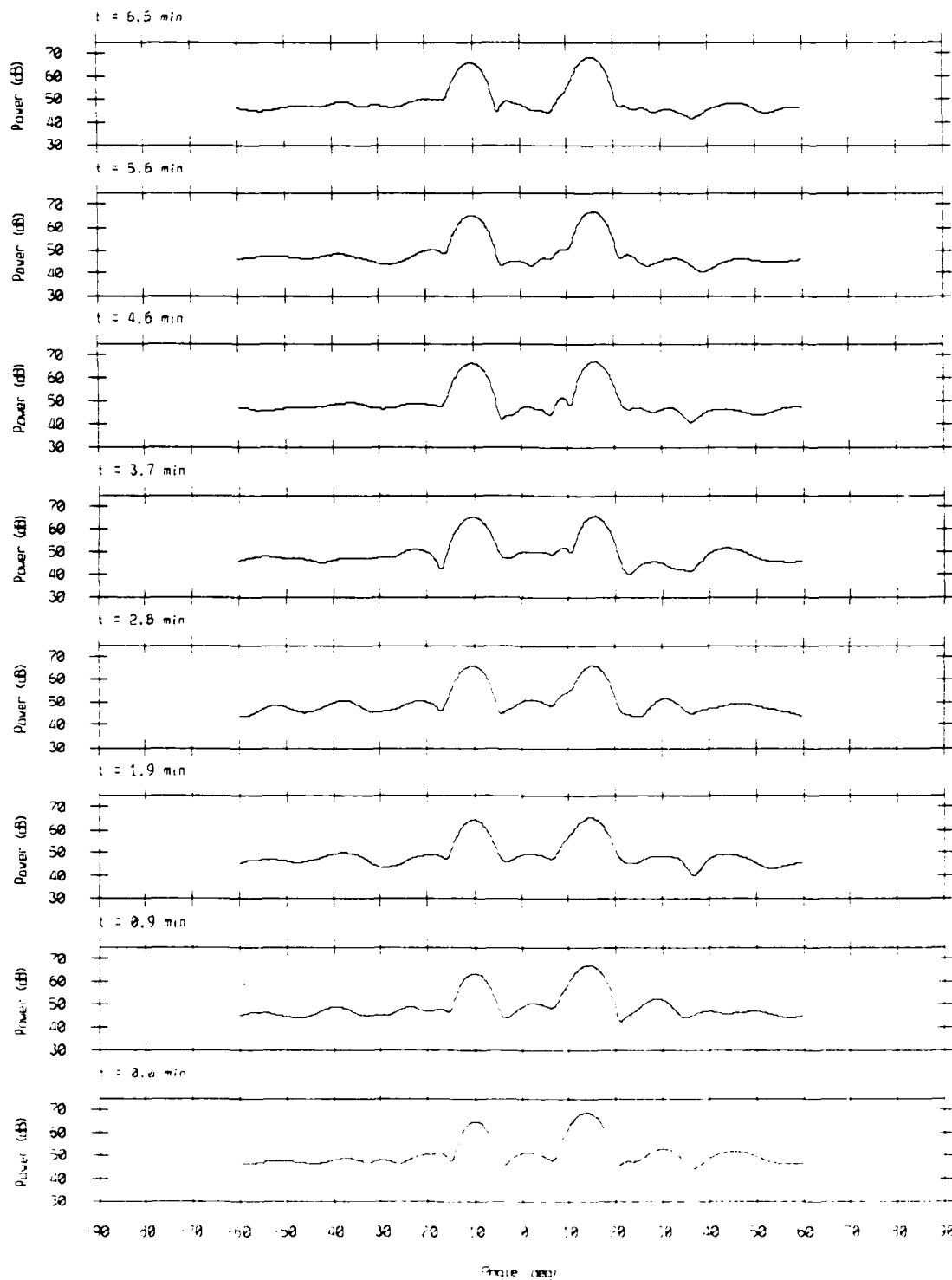
Array Response - 86247 Bin #5832

$f = 249.17$  Hz, KB window ( $\alpha = 1.5$ )



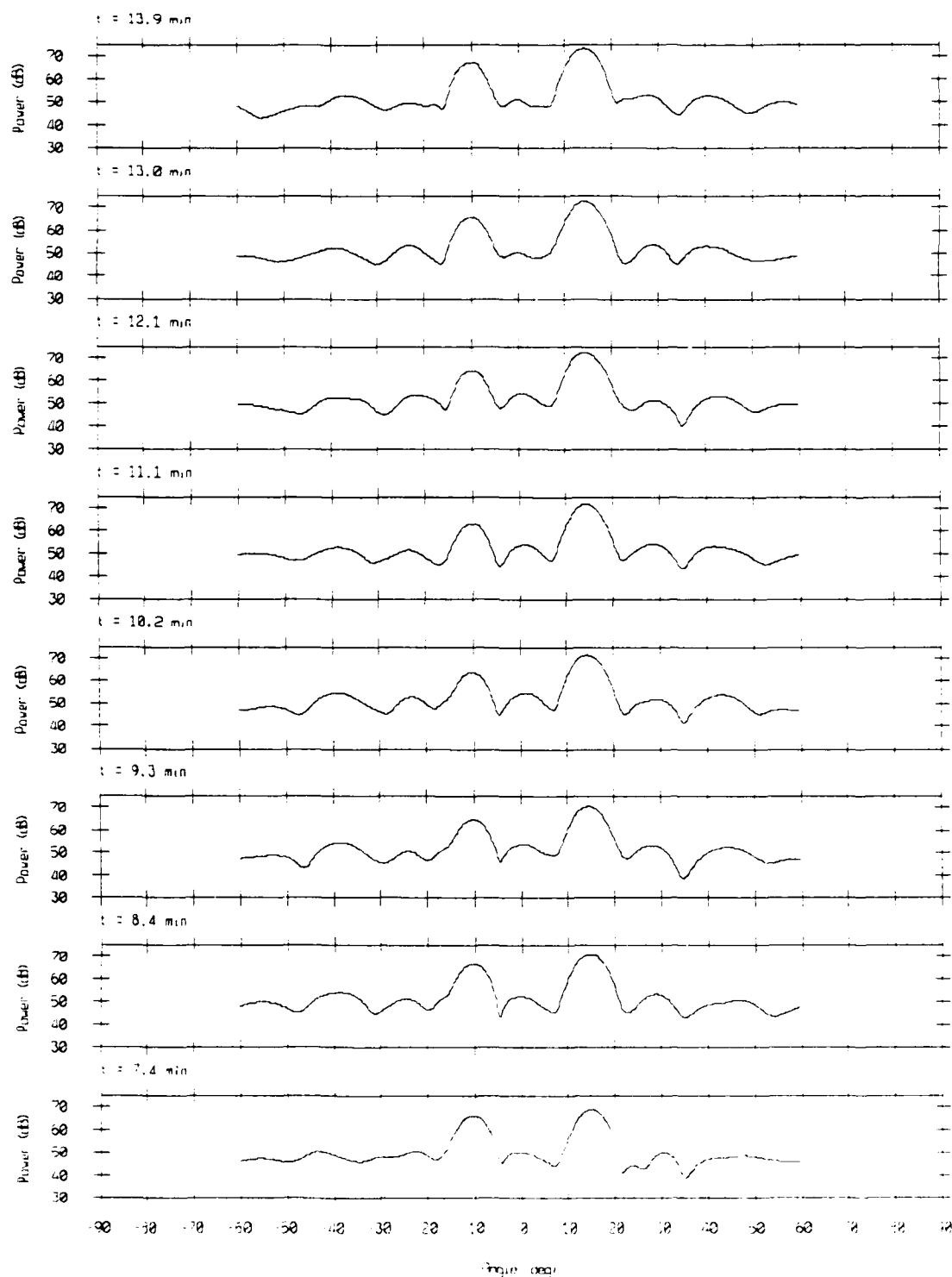
Array Response - 86247 Bin #5837

$f = 249.88$  Hz, KB window ( $\alpha = 1.5$ )



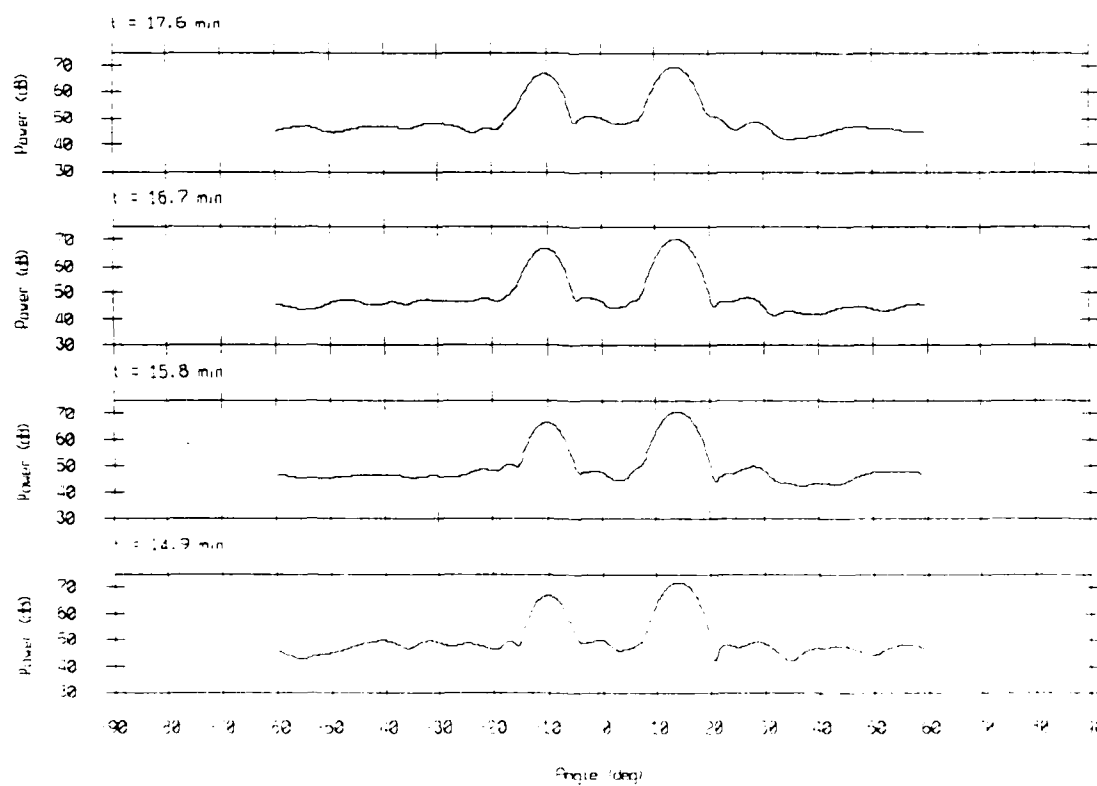
Array Response - 86247 Bin #5837

$f = 249.88$  Hz, KB window (alpha = 1.5)



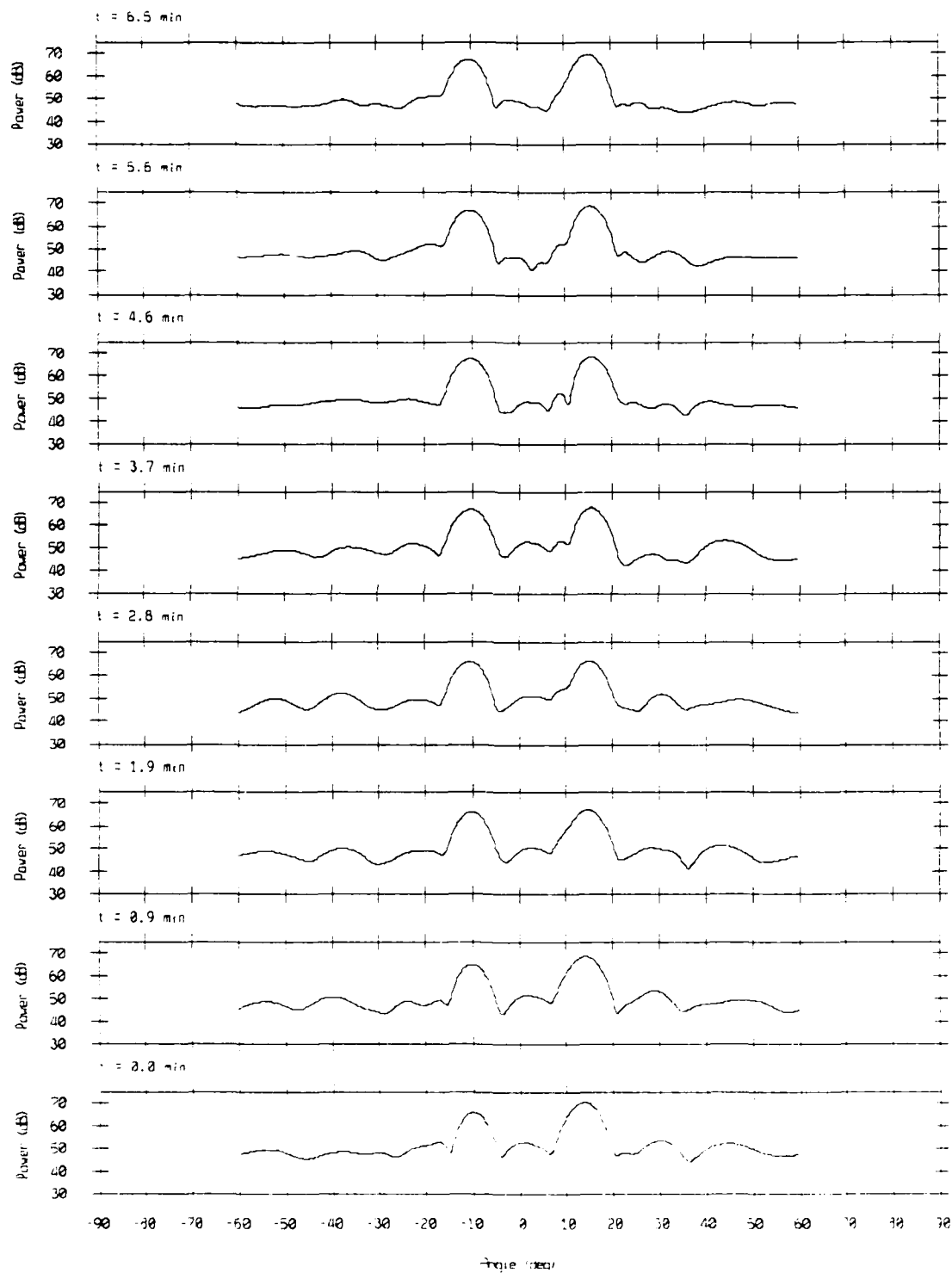
Array Response - 86247 Bin #5837

$f = 249.88$  Hz, KB window ( $\alpha = 1.5$ )



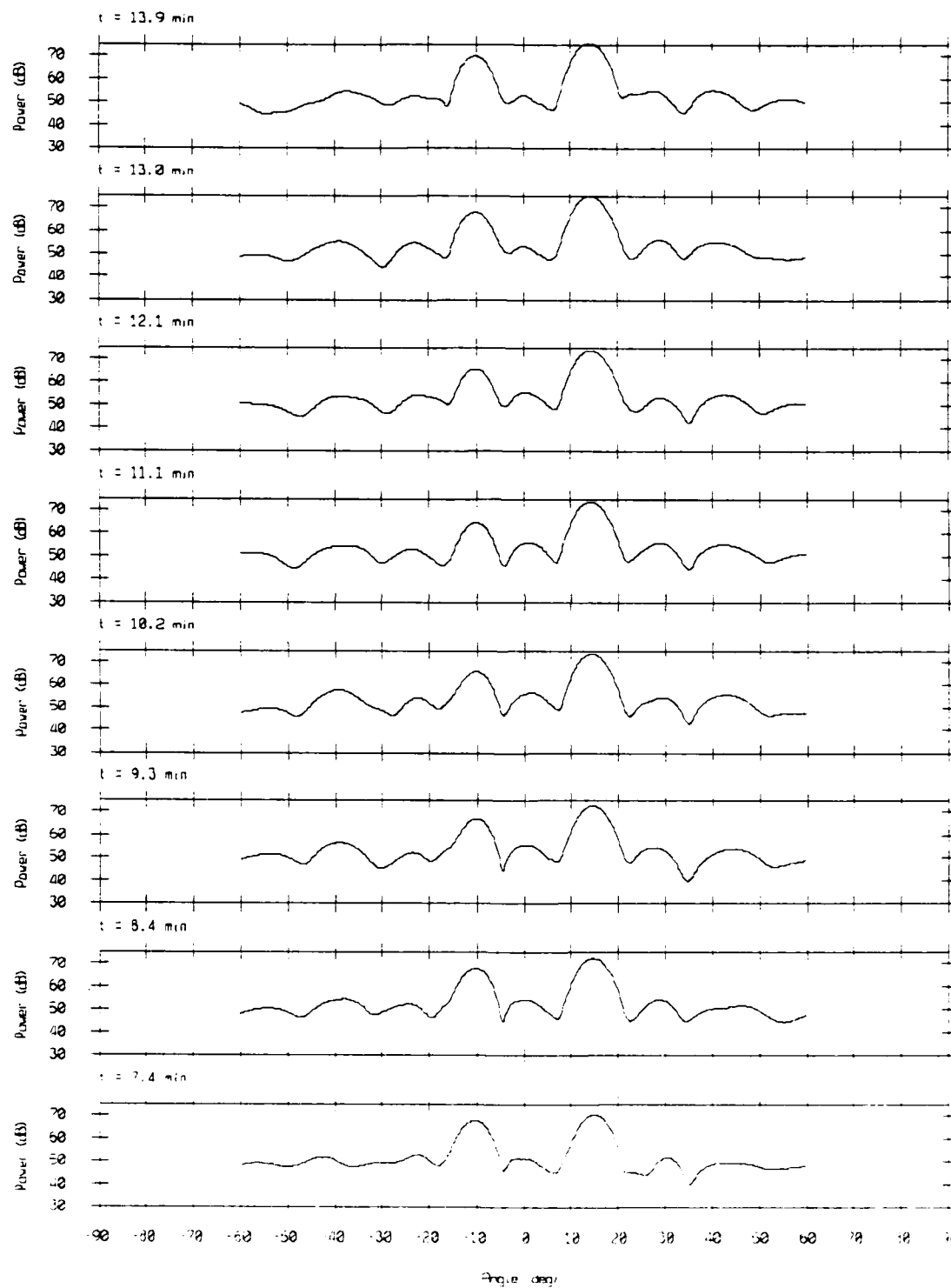
Array Response - 86247 Bin #5838

$f = 250$  Hz, KB window ( $\alpha = 1.5$ )



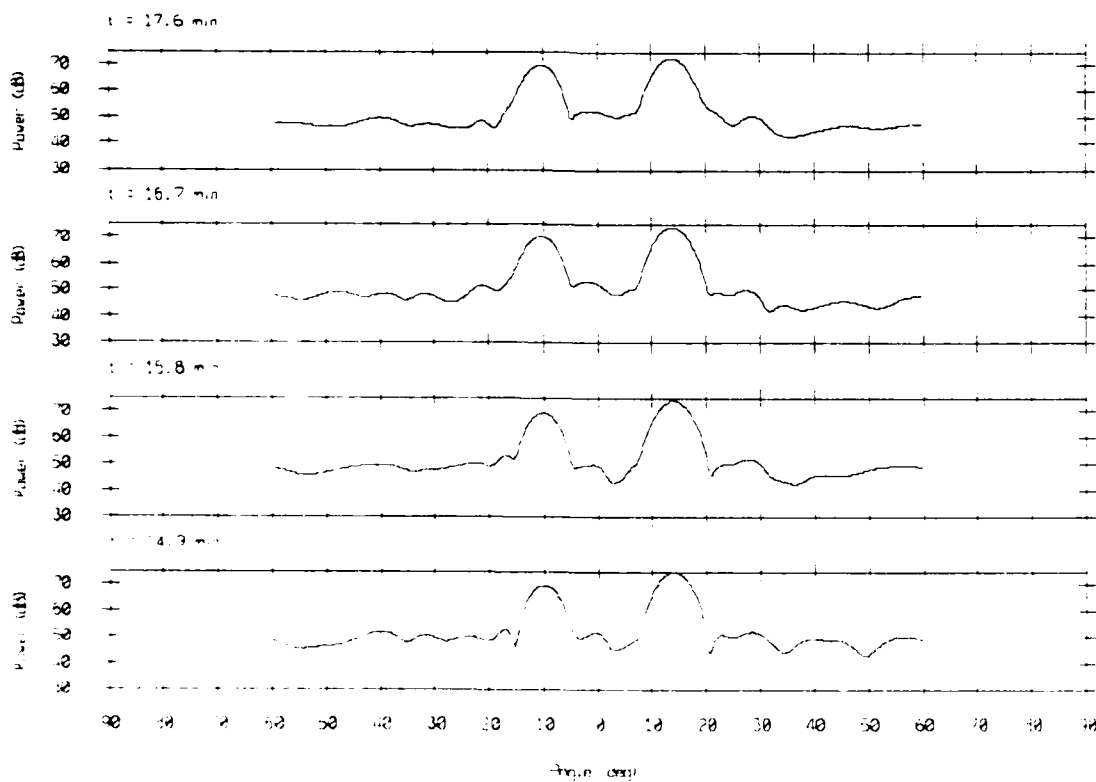
Array Response - 86247 Bin #5838

$f = 250$  Hz, KB window ( $\alpha = 1.5$ )



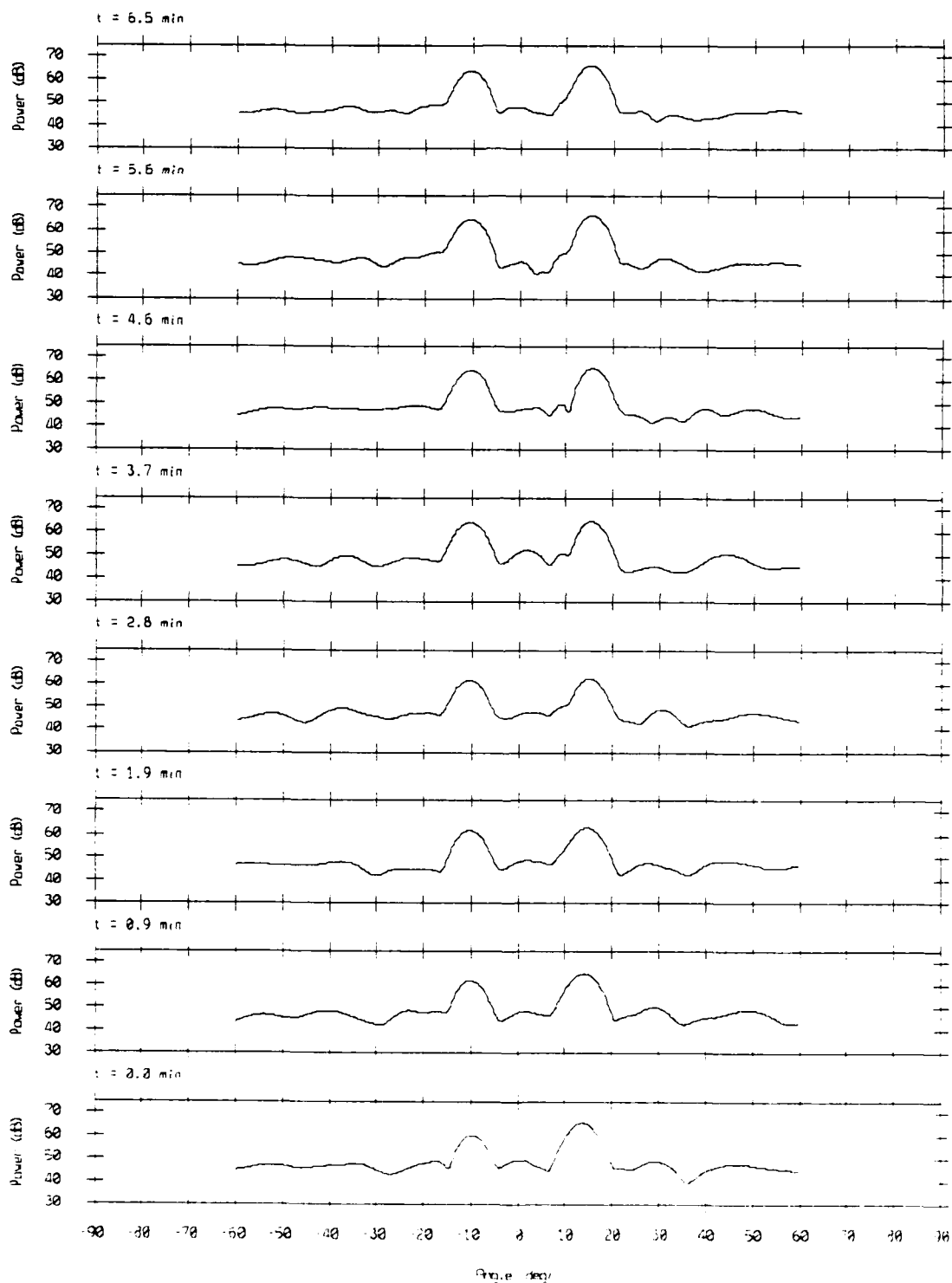
Array Response - 86247 Bin #5838

$f = 250$  Hz, KB window ( $\alpha = 1.5$ )



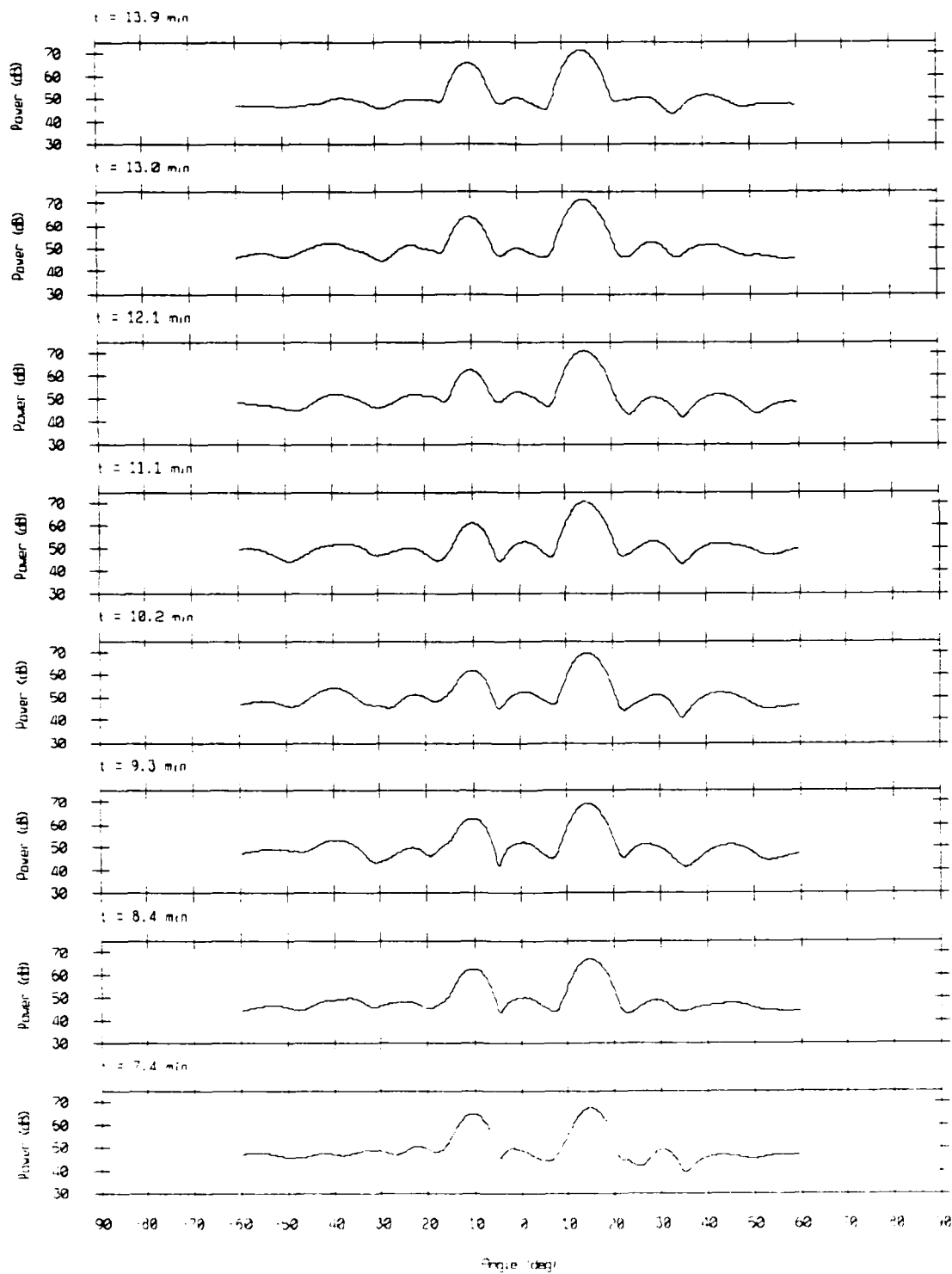
Array Response - 86247 Bin #5839

$f = 250.17$  Hz, KB window ( $\alpha = 1.5$ )



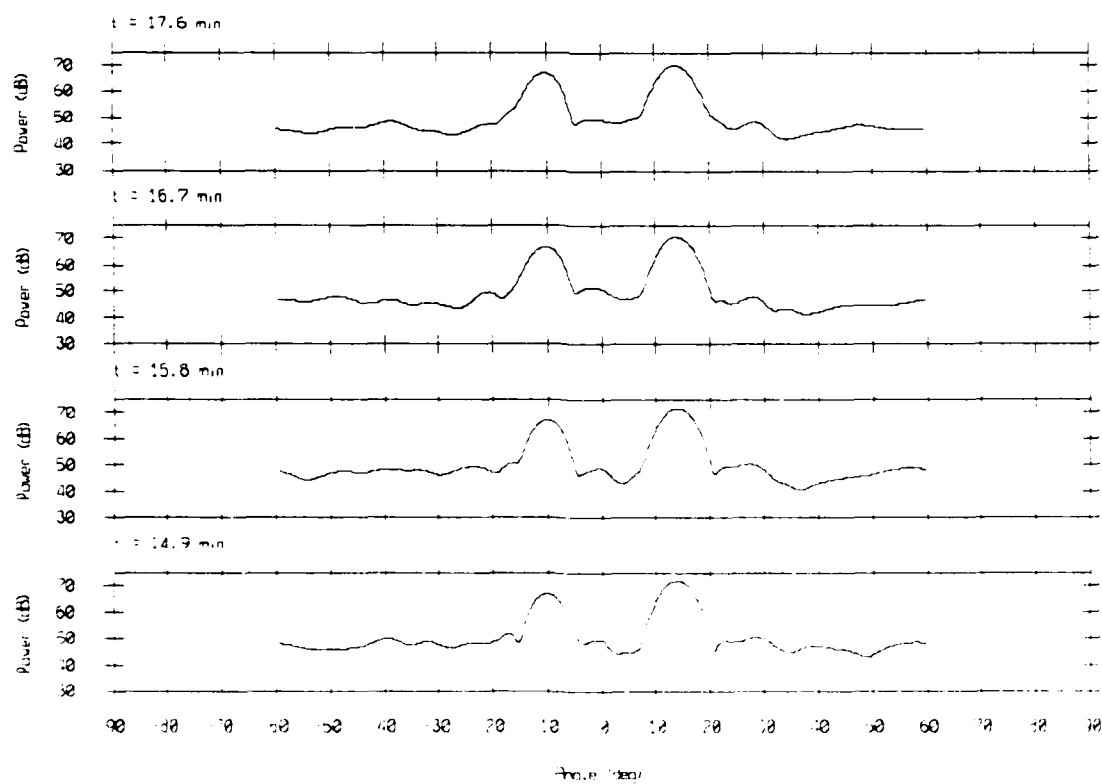
Array Response - 86247 Bin #5839

$f = 250.17$  Hz, KB window ( $\alpha = 1.5$ )



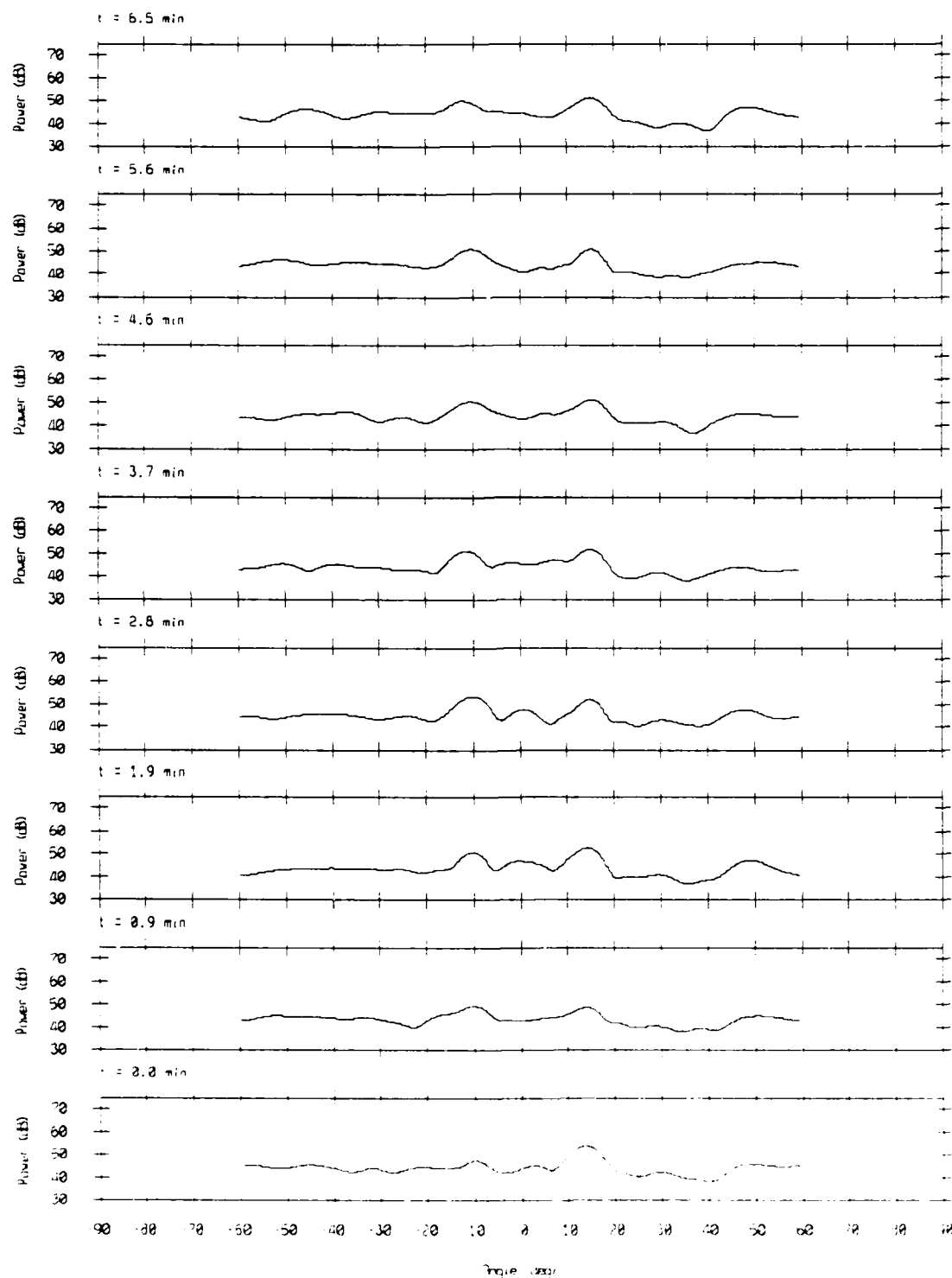
Array Response - 86247 Bin #5839

$f = 250.17$  Hz, KB window ( $\alpha = 1.5$ )



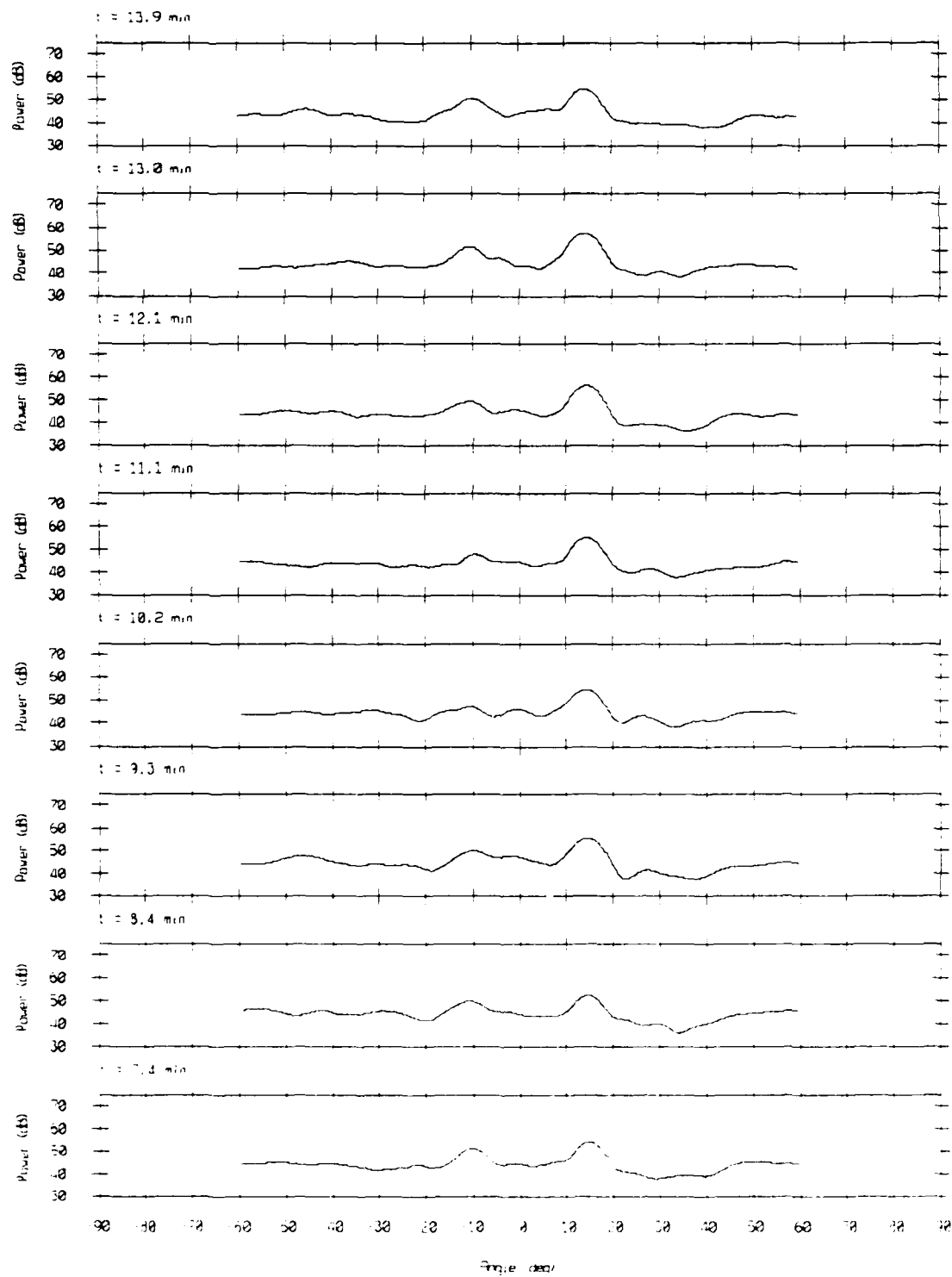
Array Response - 86247 Bin #5844

$f = 250.89$  Hz, KB window ( $\alpha = 1.5$ )



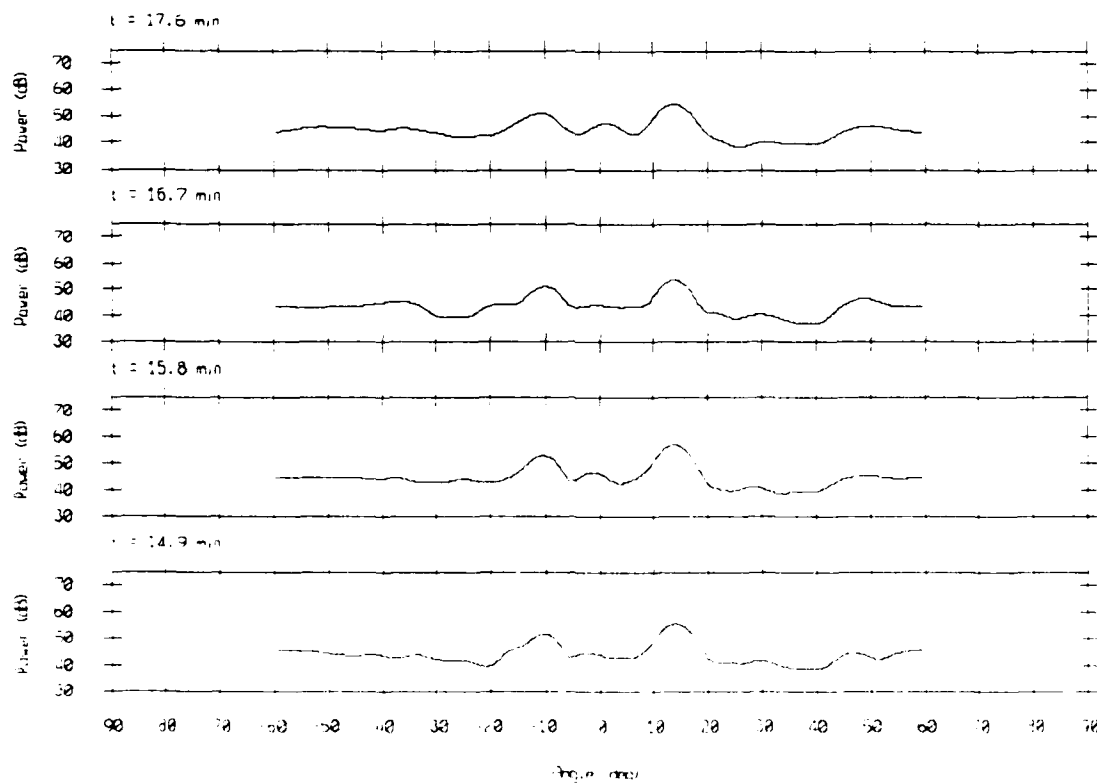
# Array Response - 86247 Bin #5844

$f = 250.89$  Hz, KB window ( $\alpha = 1.5$ )



Array Response - 86247 Bin #5844

$f = 250.89$  Hz, KB window ( $\alpha = 1.5$ )

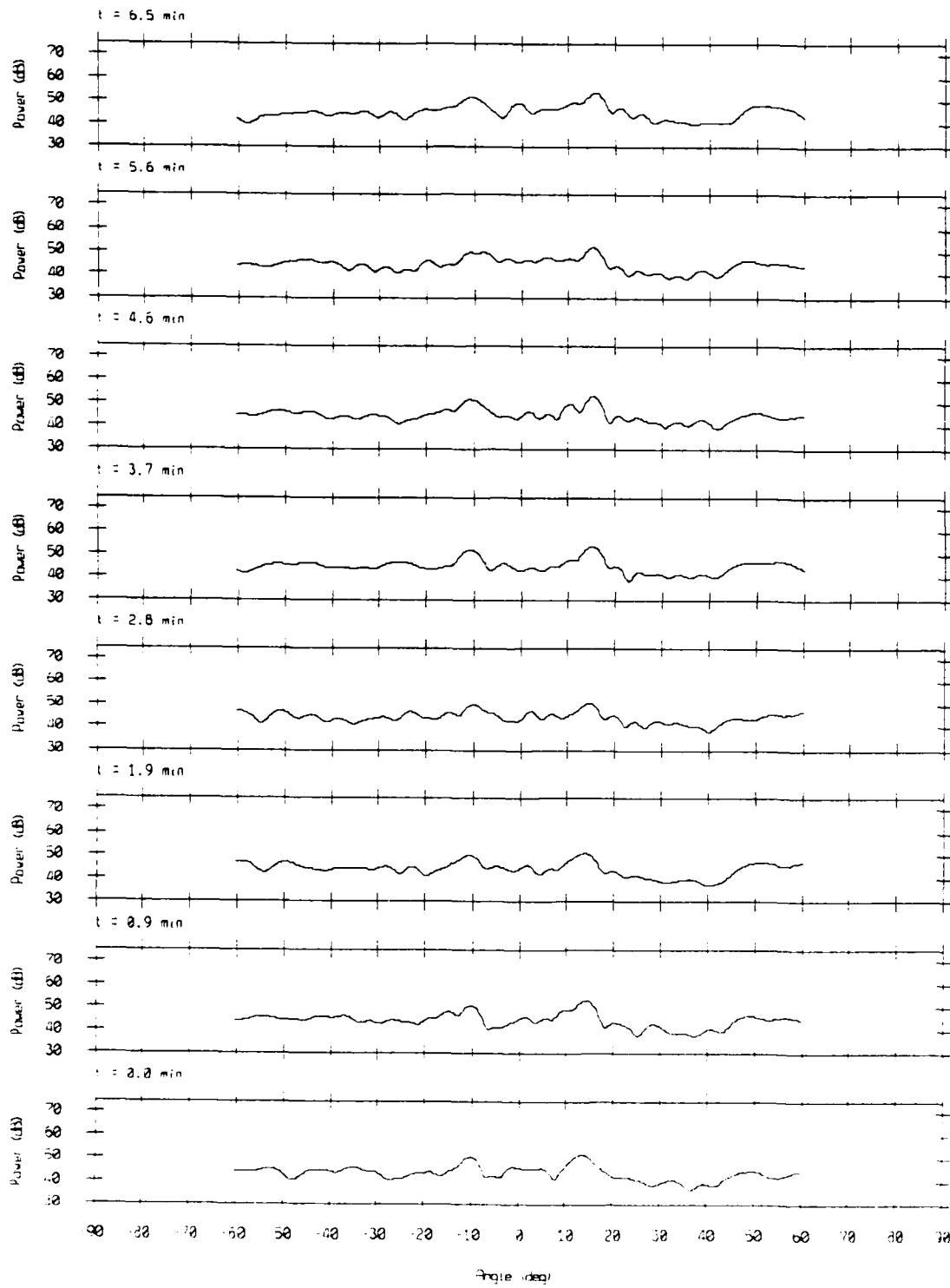


V. Tape #86247.

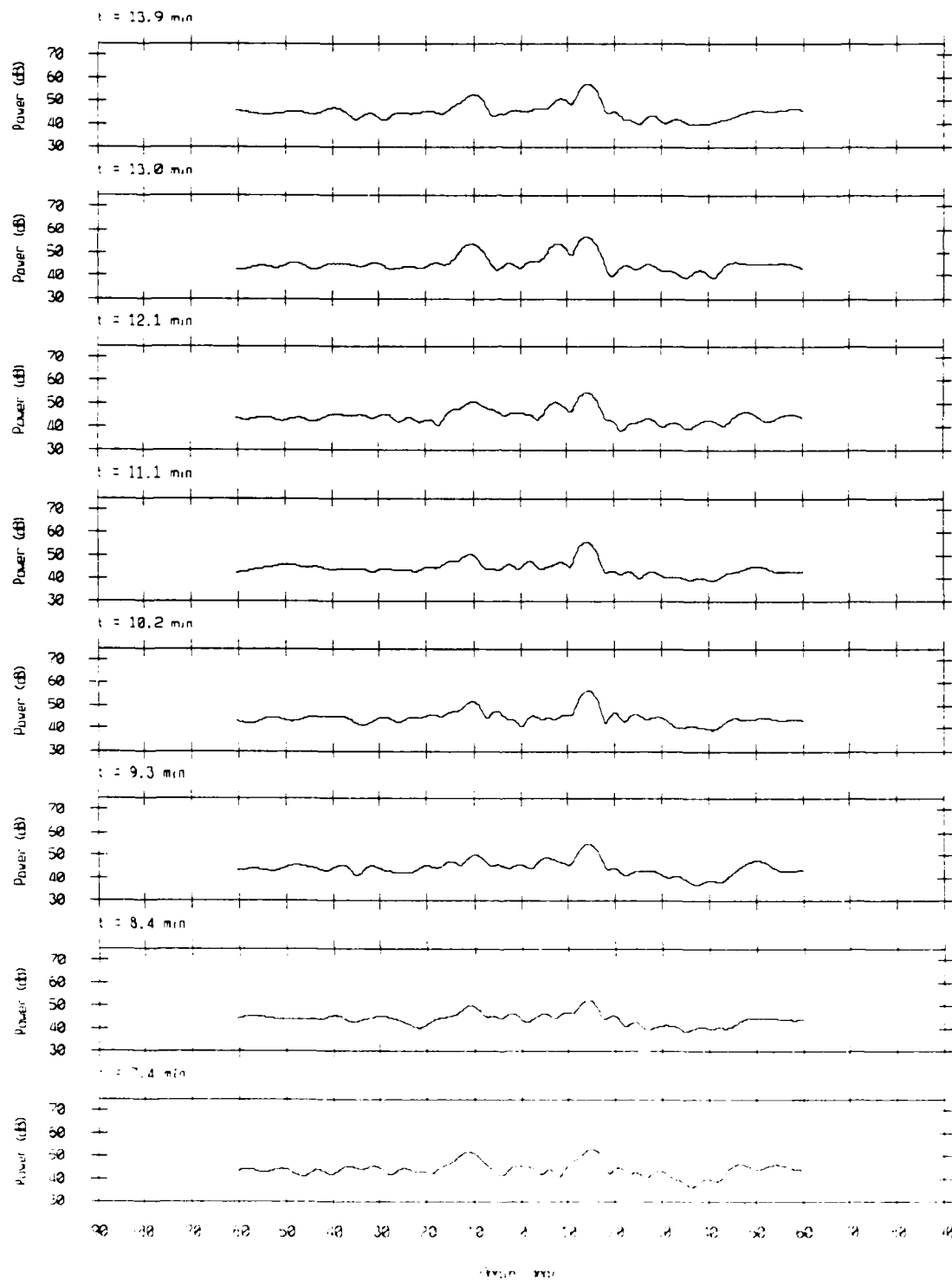
F. Array Response: Panels, Rect Window.

Array Response - 86247 Bin #5832

$f = 249.17$  Hz, rect window

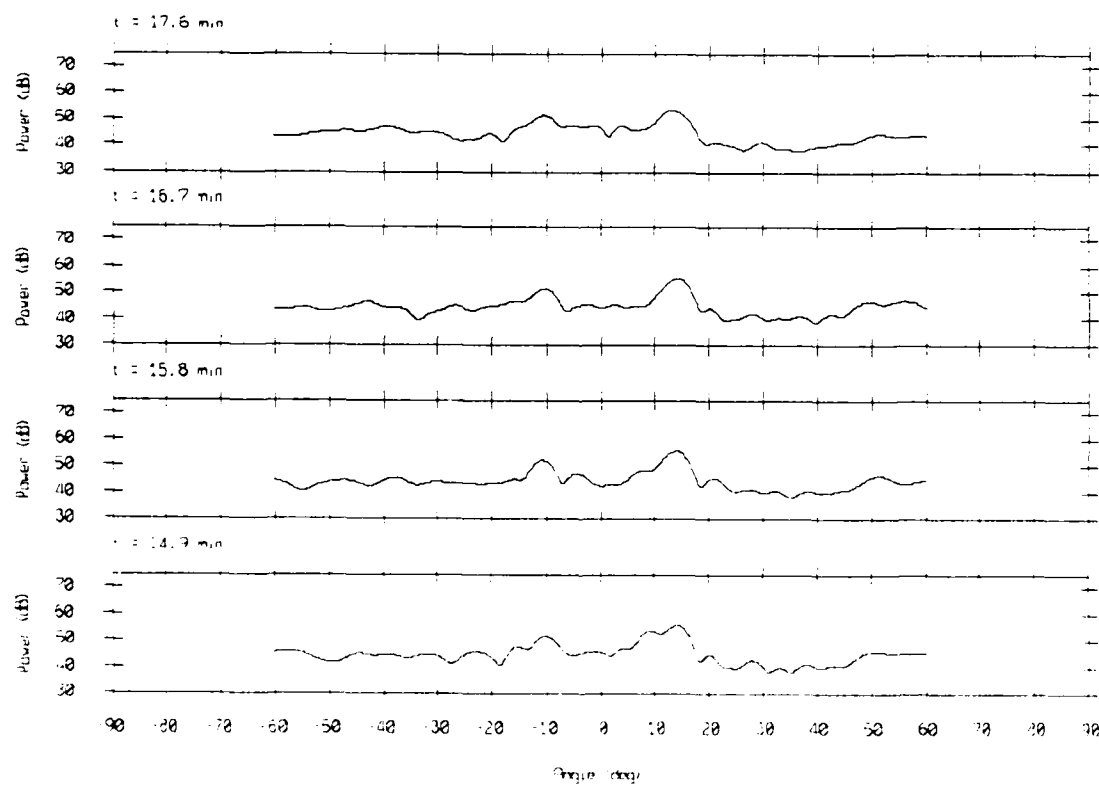


$f = 249.17$  Hz, rect window



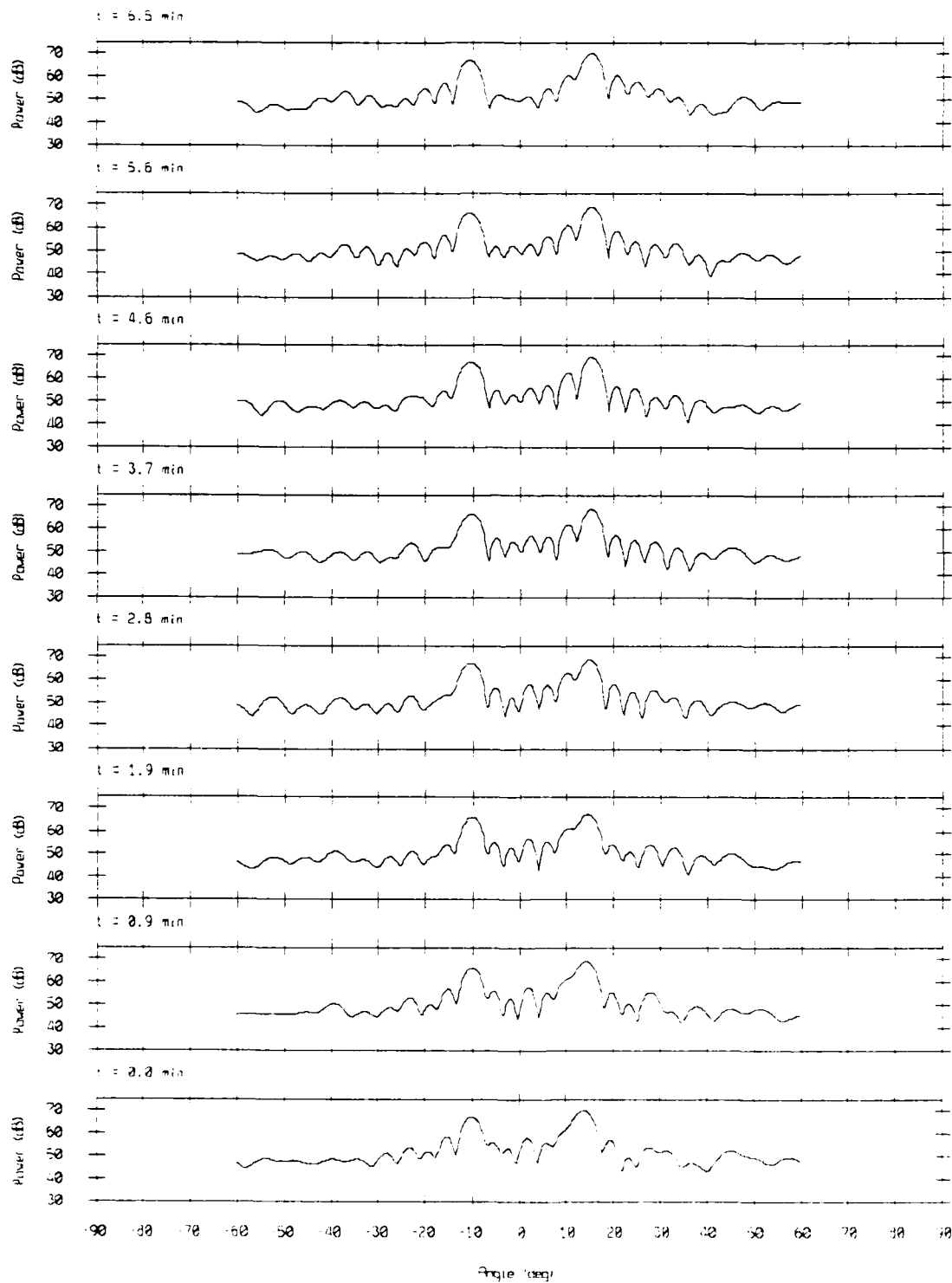
Array Response - 86247 Bin #5832

$f = 249.17$  Hz, rect window



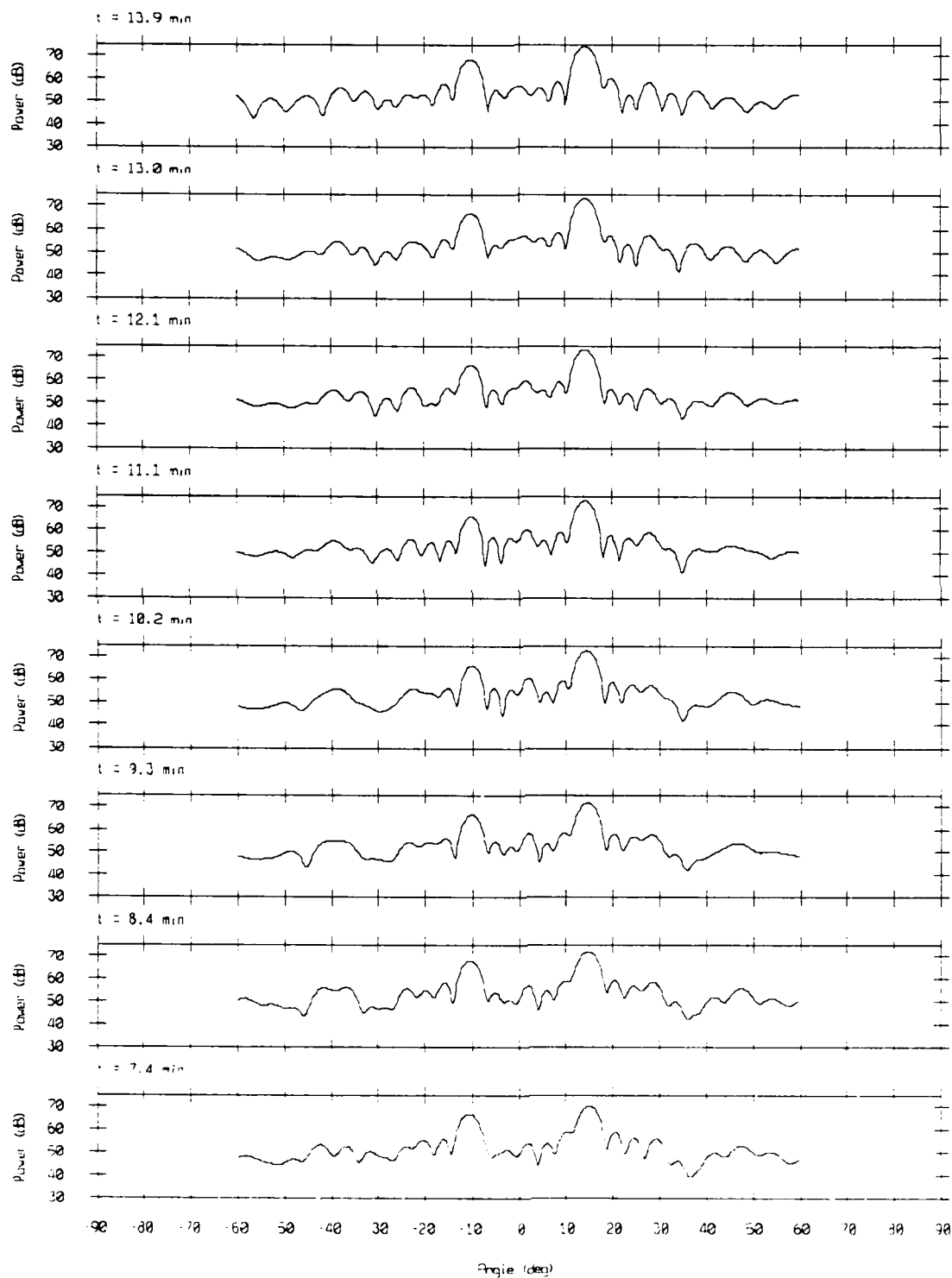
# Array Response - 86247 Bin #5837

$f = 249.88$  Hz, rect window



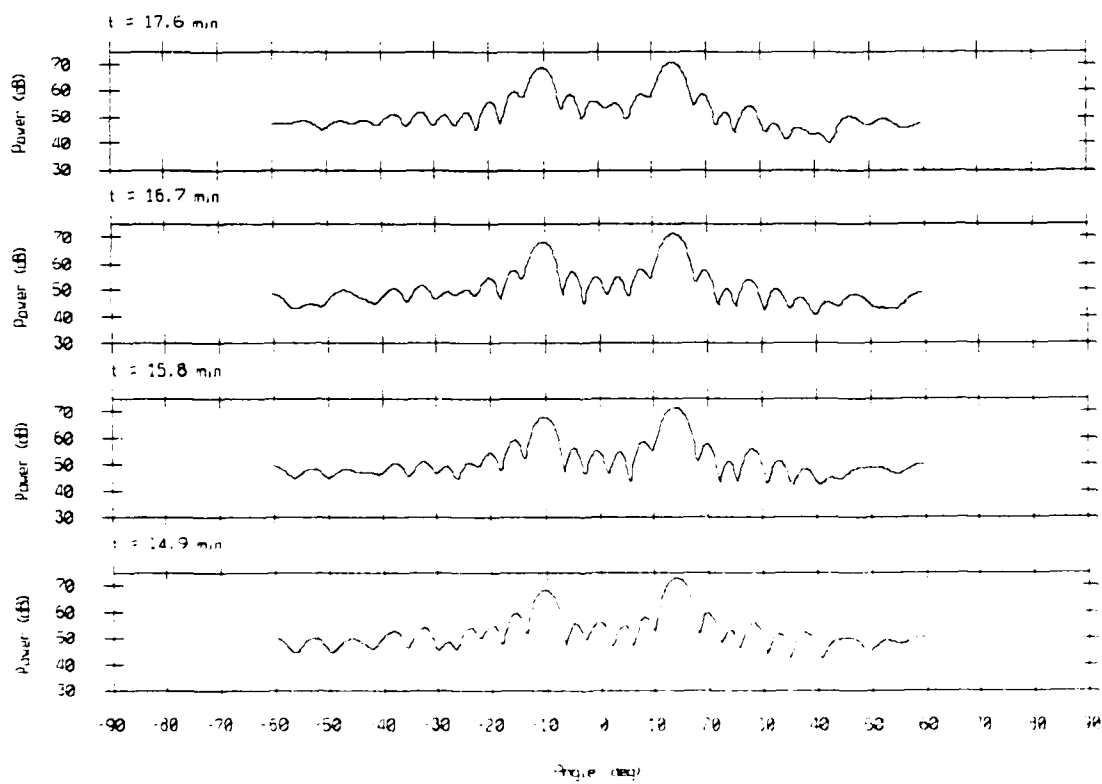
Array Response - 86247 Bin #5837

$f = 249.88$  Hz, rect window



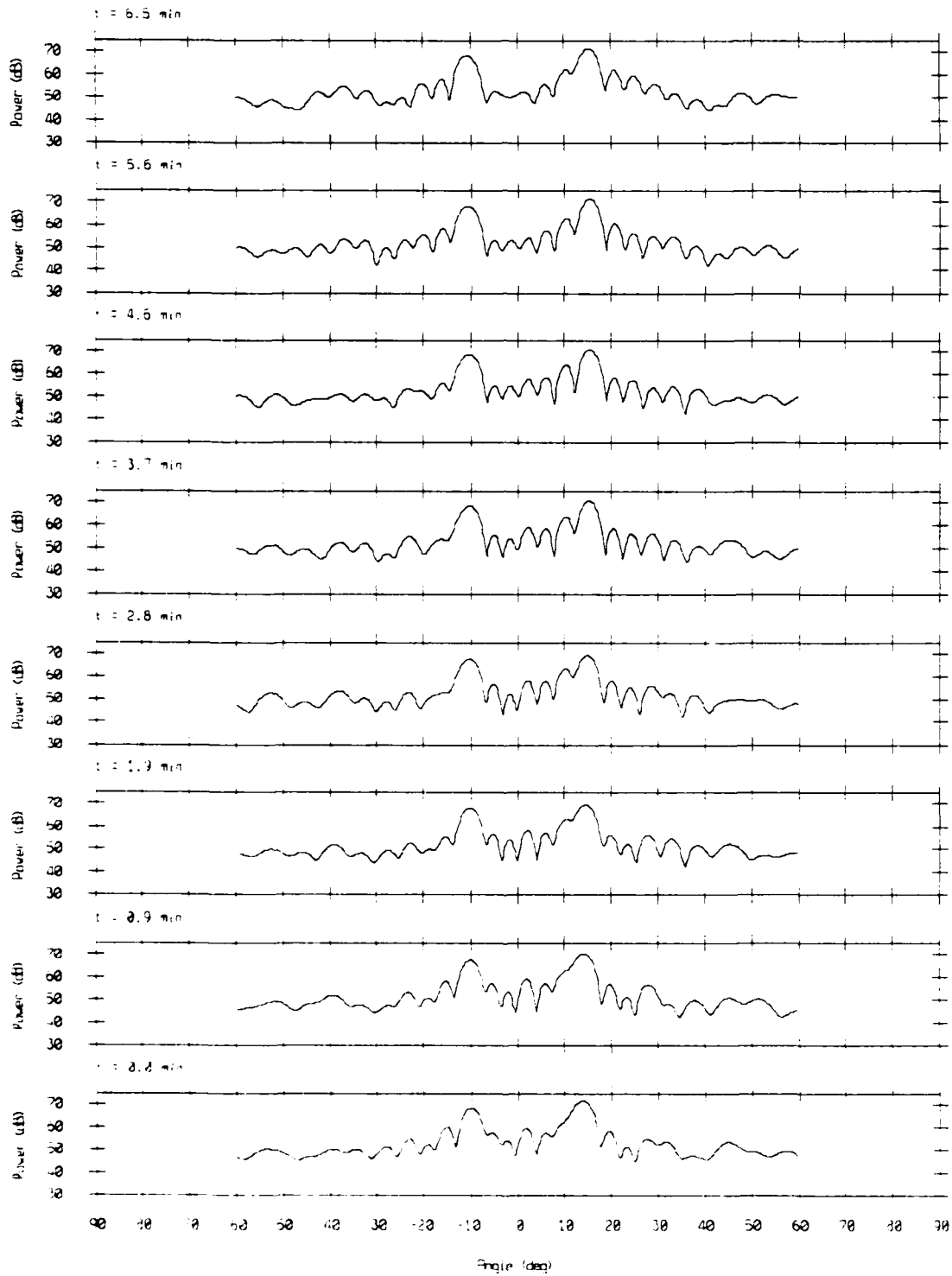
Array Response - 86247 Bin #5837

$f = 249.88$  Hz, rect window



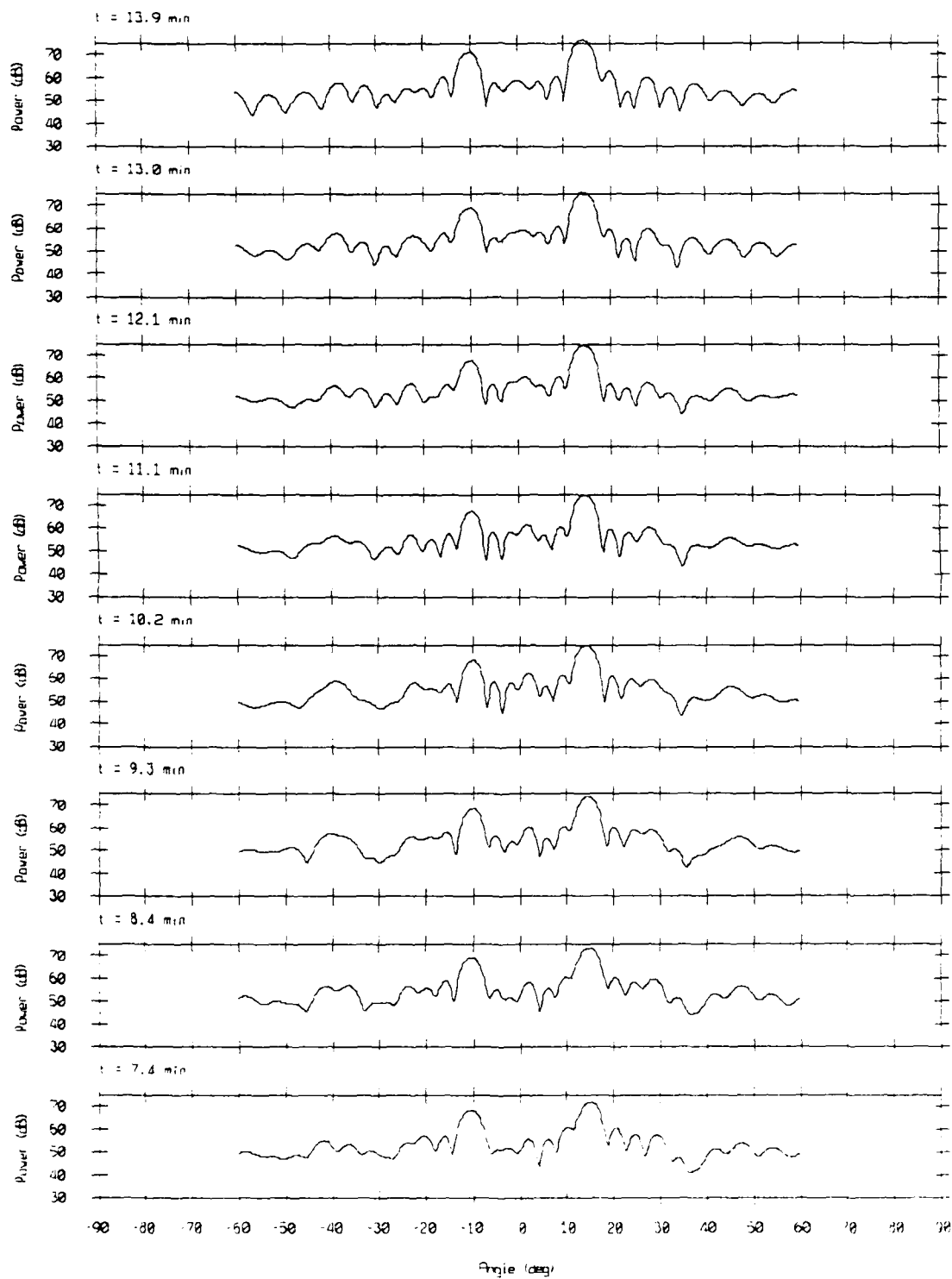
# Array Response - 86247 Bin #5838

$\Delta f = 250$  Hz, rect window



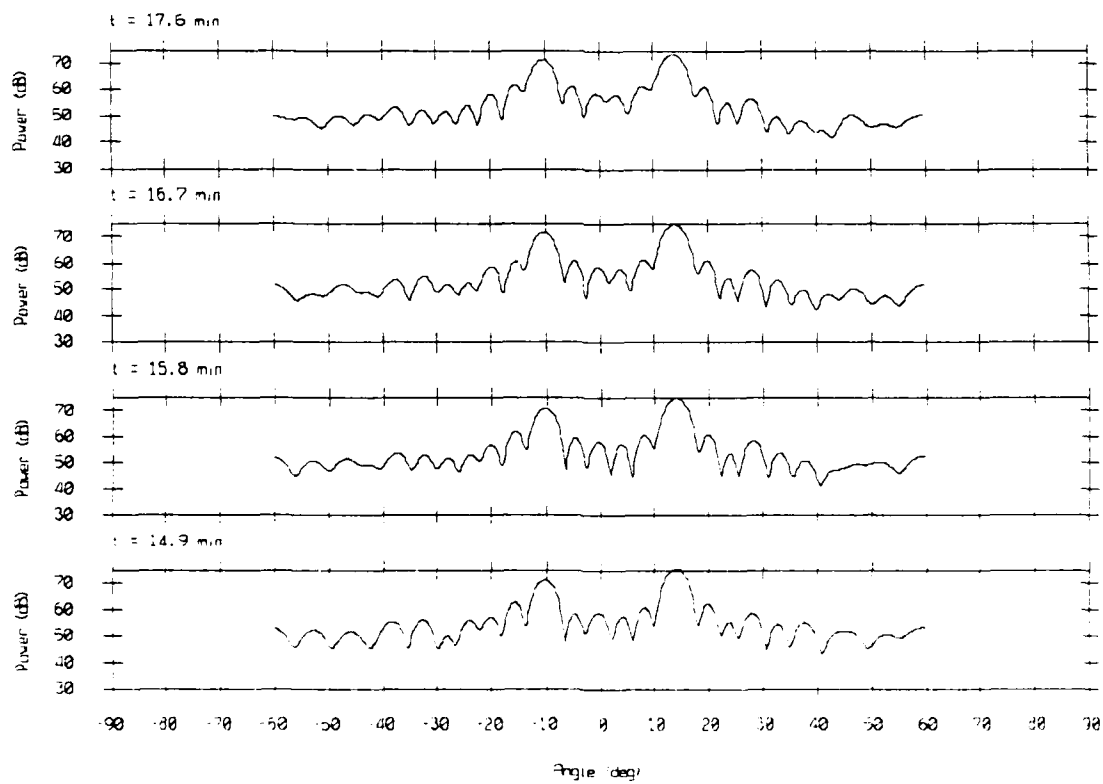
Array Response - 86247 Bin #5838

$f = 250$  Hz, rect window



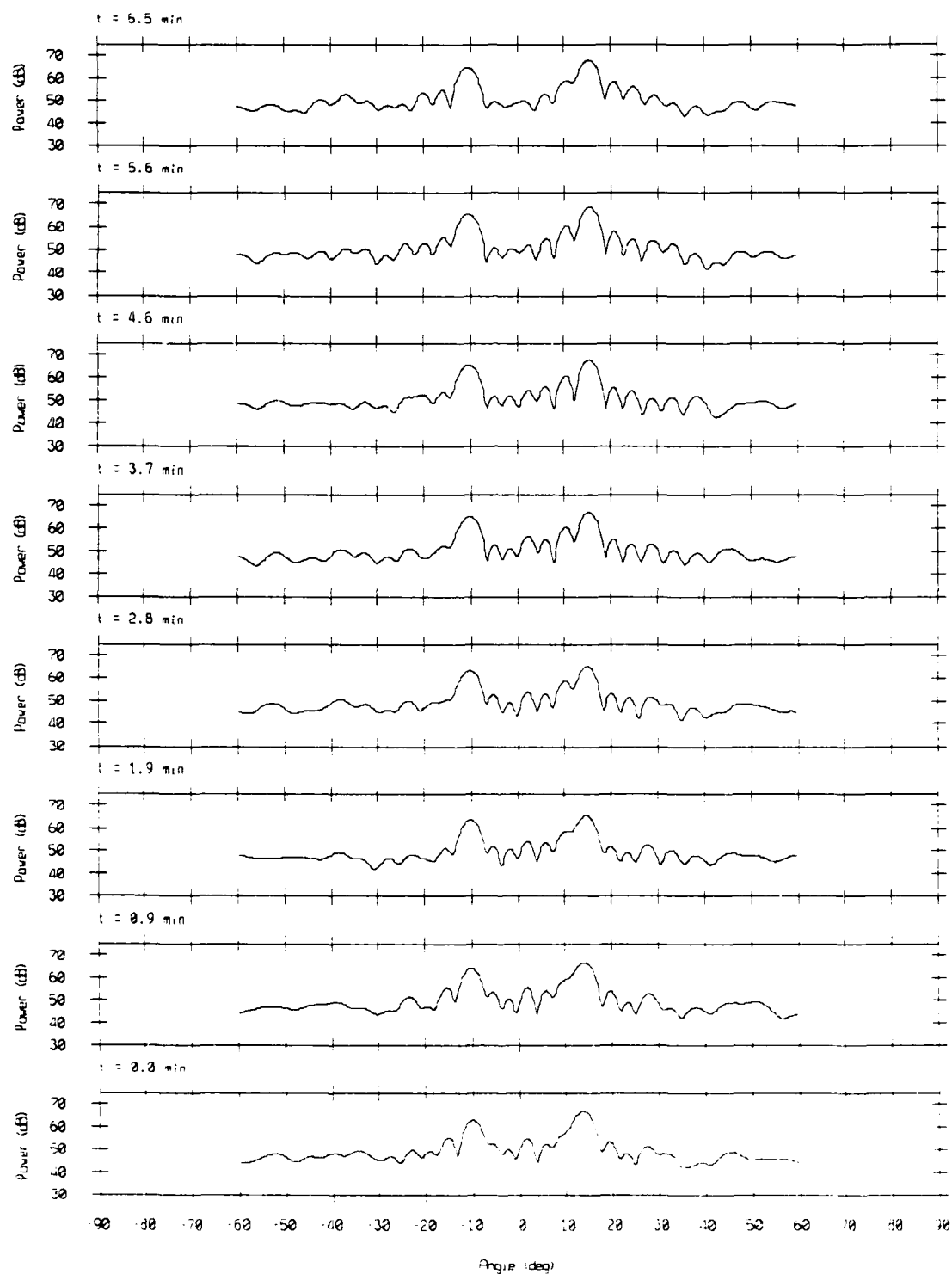
Array Response - 86247 Bin #5838

$f = 250$  Hz, rect window



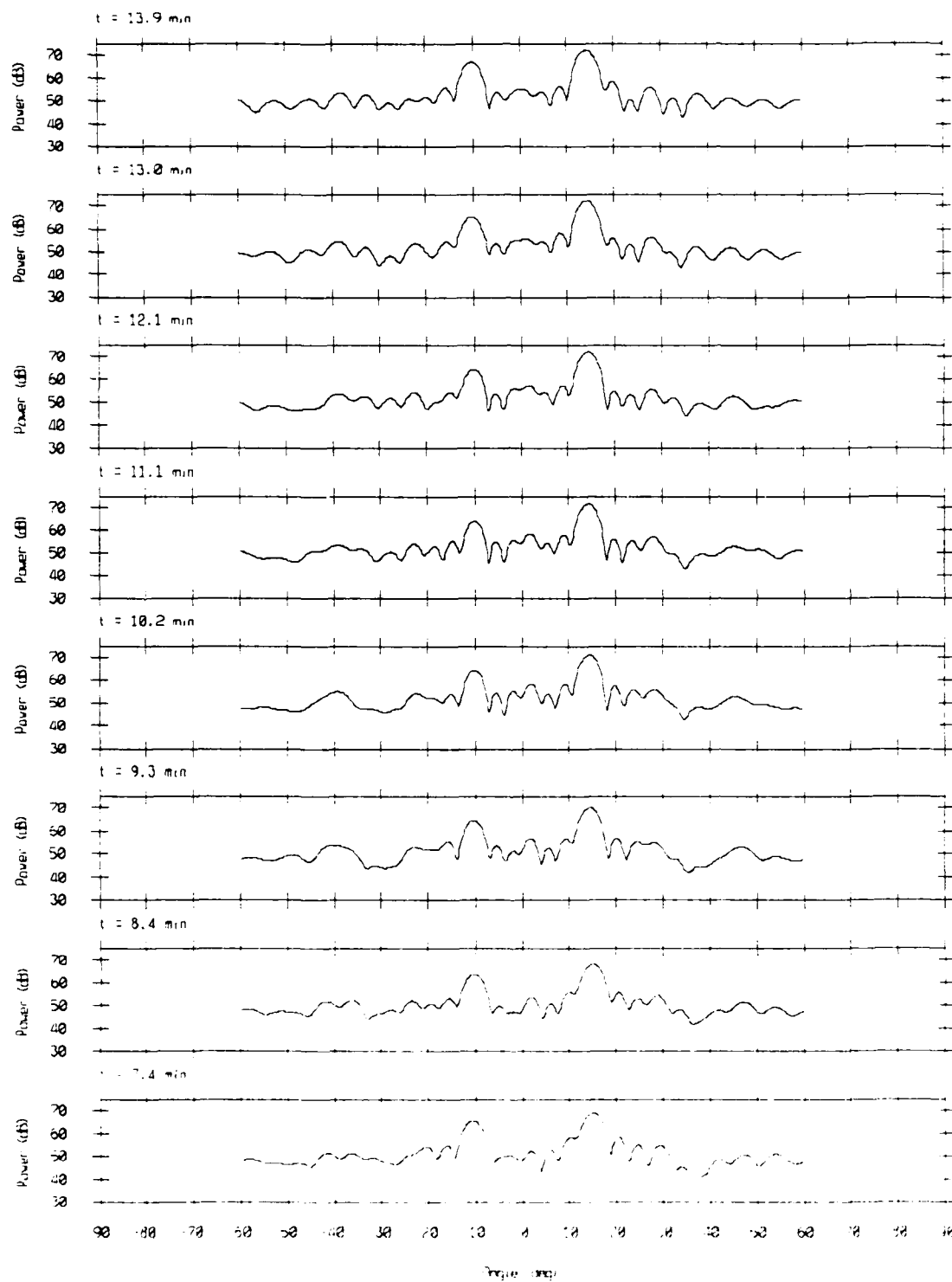
Array Response - 86247 Bin #5839

$f = 250.17$  Hz, rect window



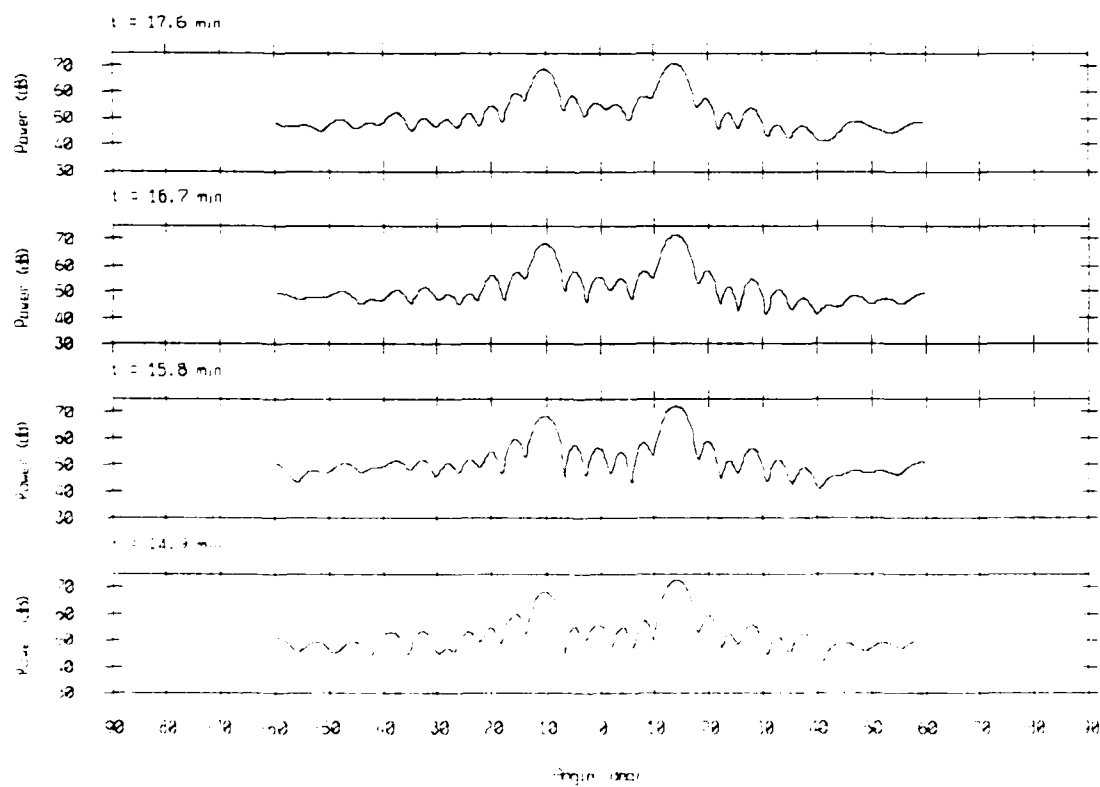
Array Response - 86247 Bin #5839

$f = 250.17$  Hz, rect window



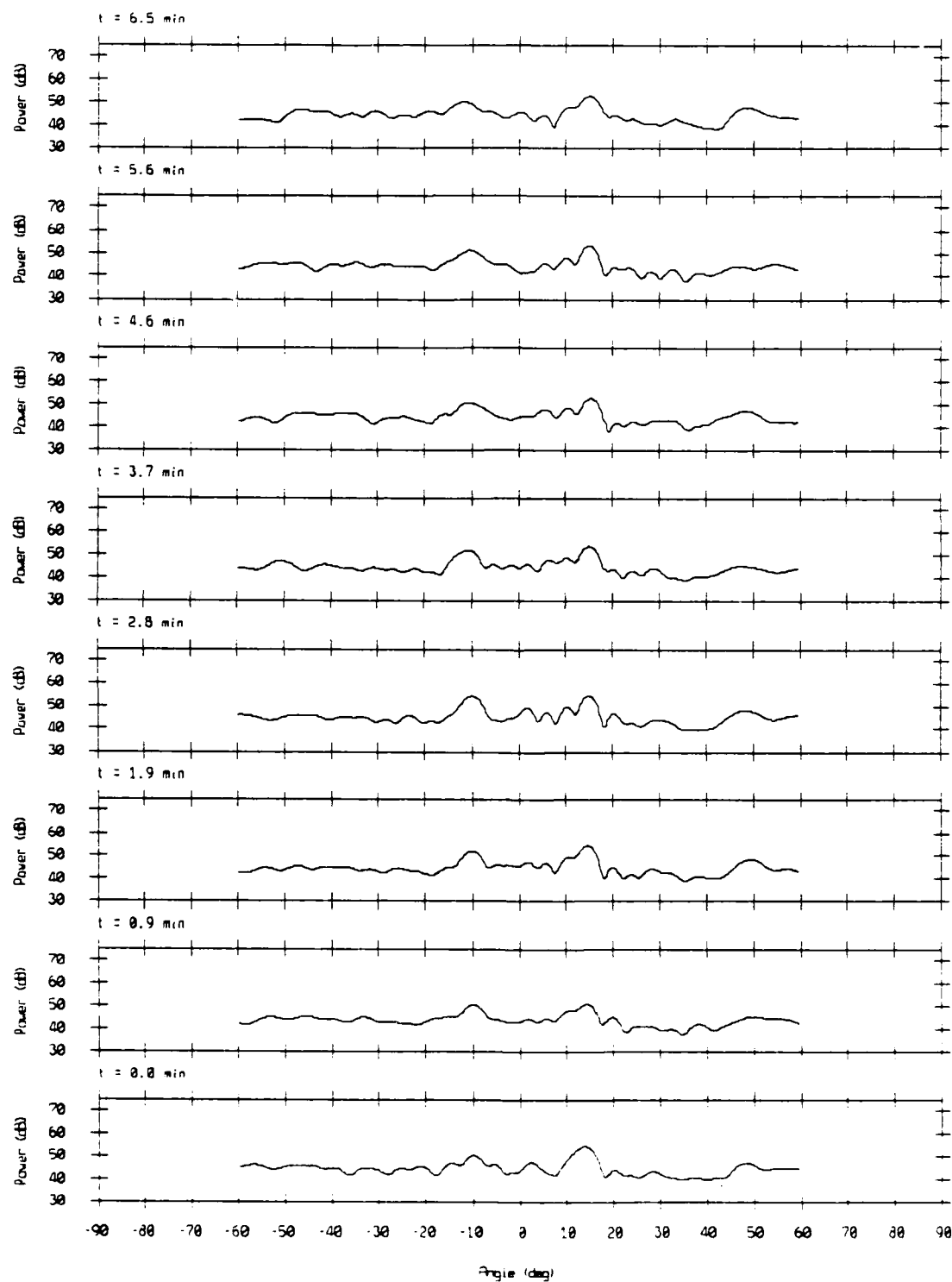
Array Response - 86247 Bin #5839

$f = 250.17$  Hz, rect window



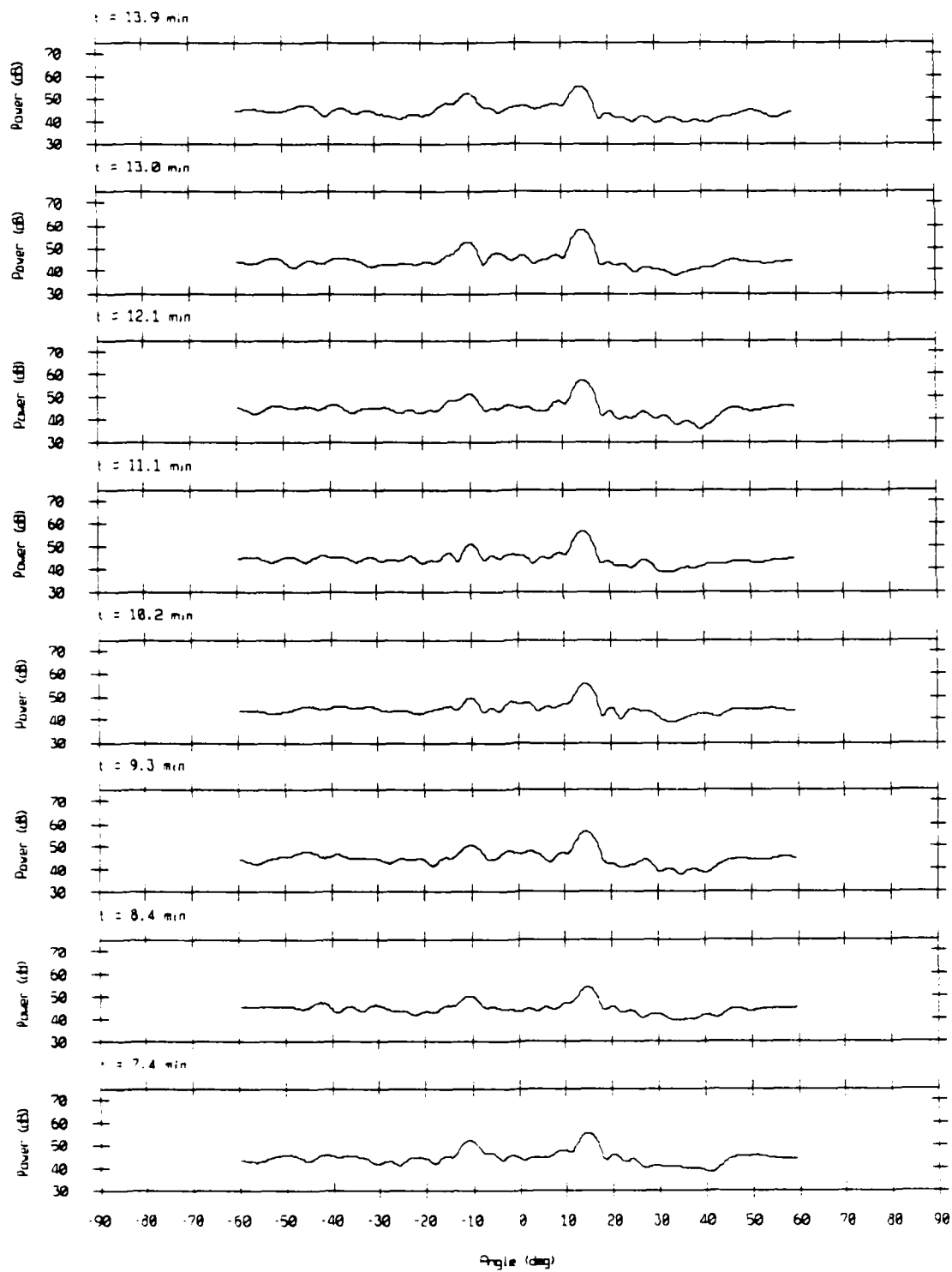
# Array Response - 86247 Bin #5844

$f = 250.89$  Hz, rect window



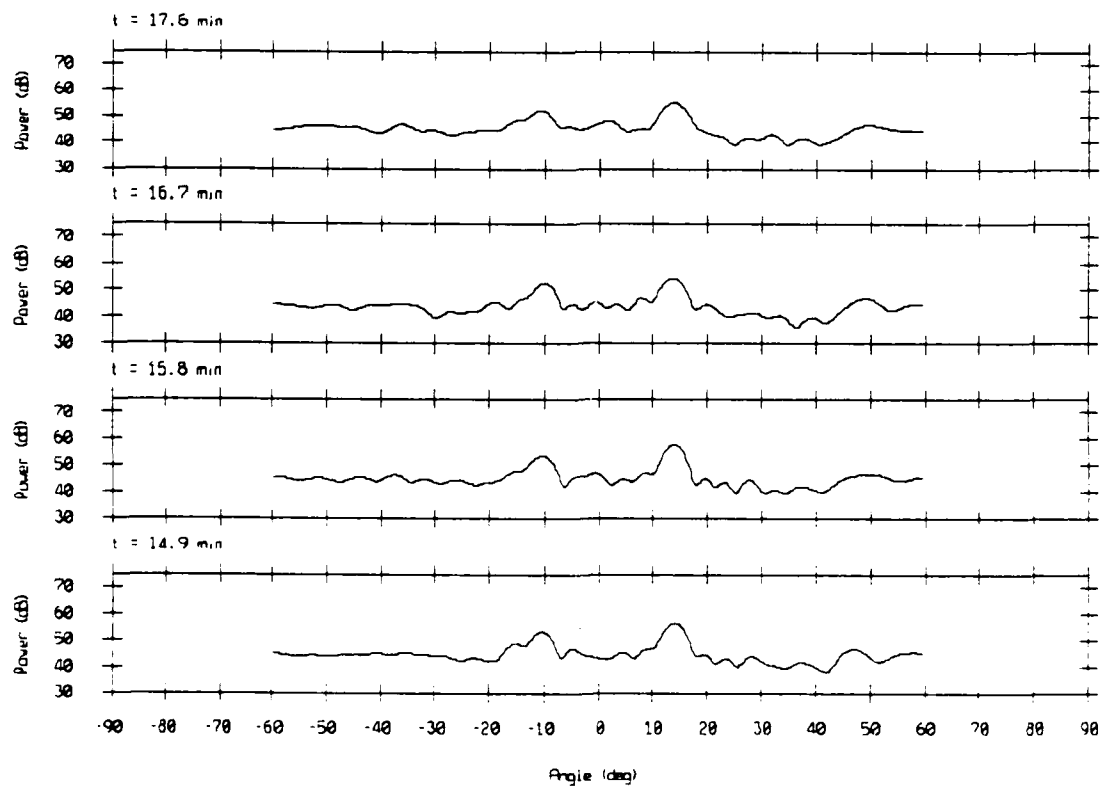
# Array Response - 86247 Bin #5844

$f = 250.89$  Hz, rect window



Array Response - 86247 Bin #5844

$f = 250.89$  Hz, rect window



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